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OFFICIAL PUBLICATION
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PROCEEDINGS
AMERICAN ASSOCIATION
OF TEXTILE CHEMISTS
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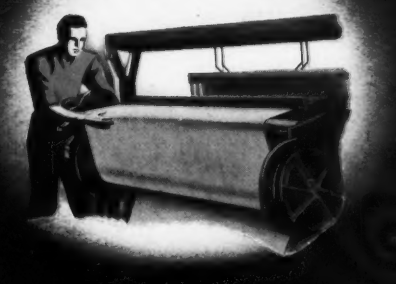

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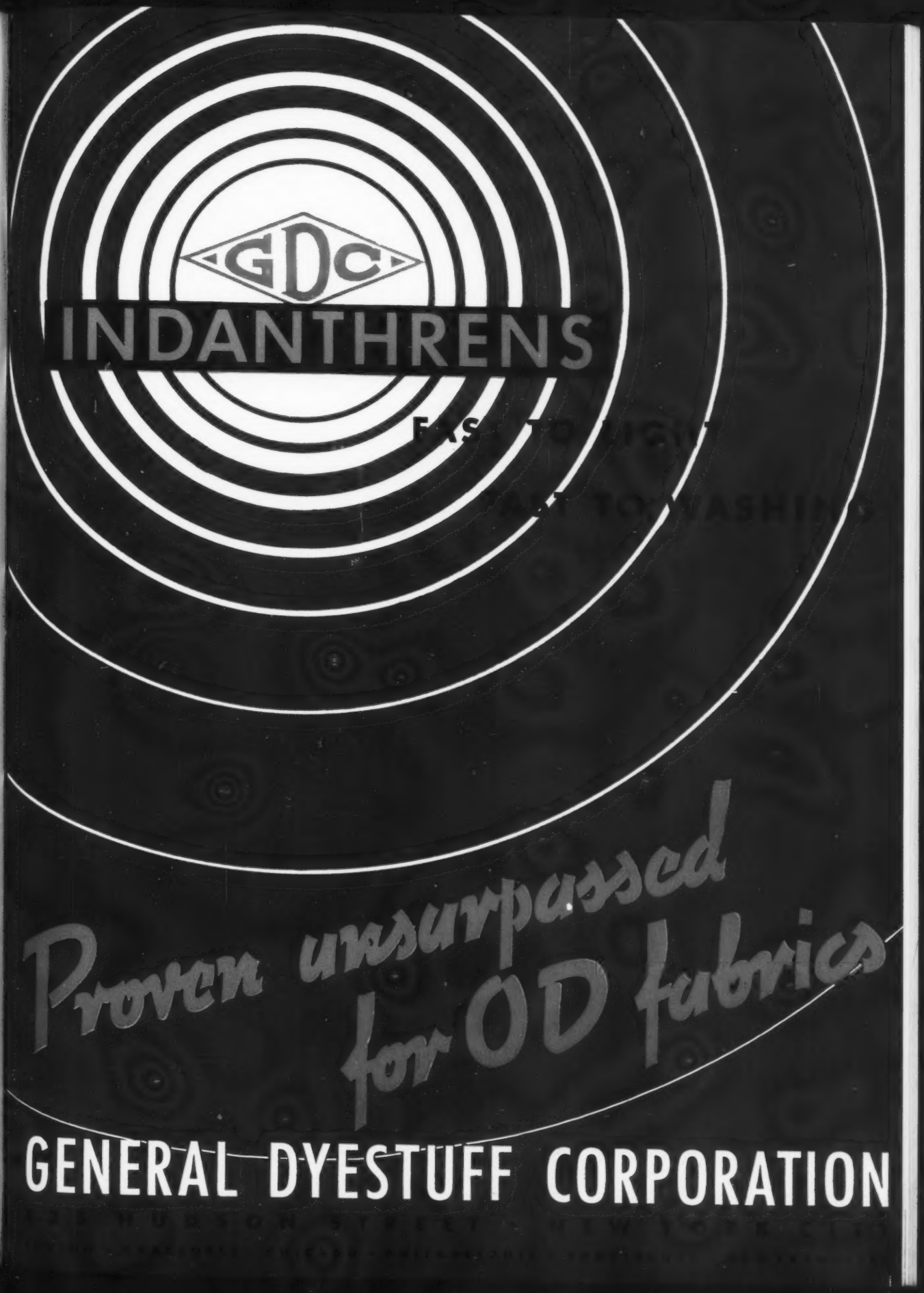
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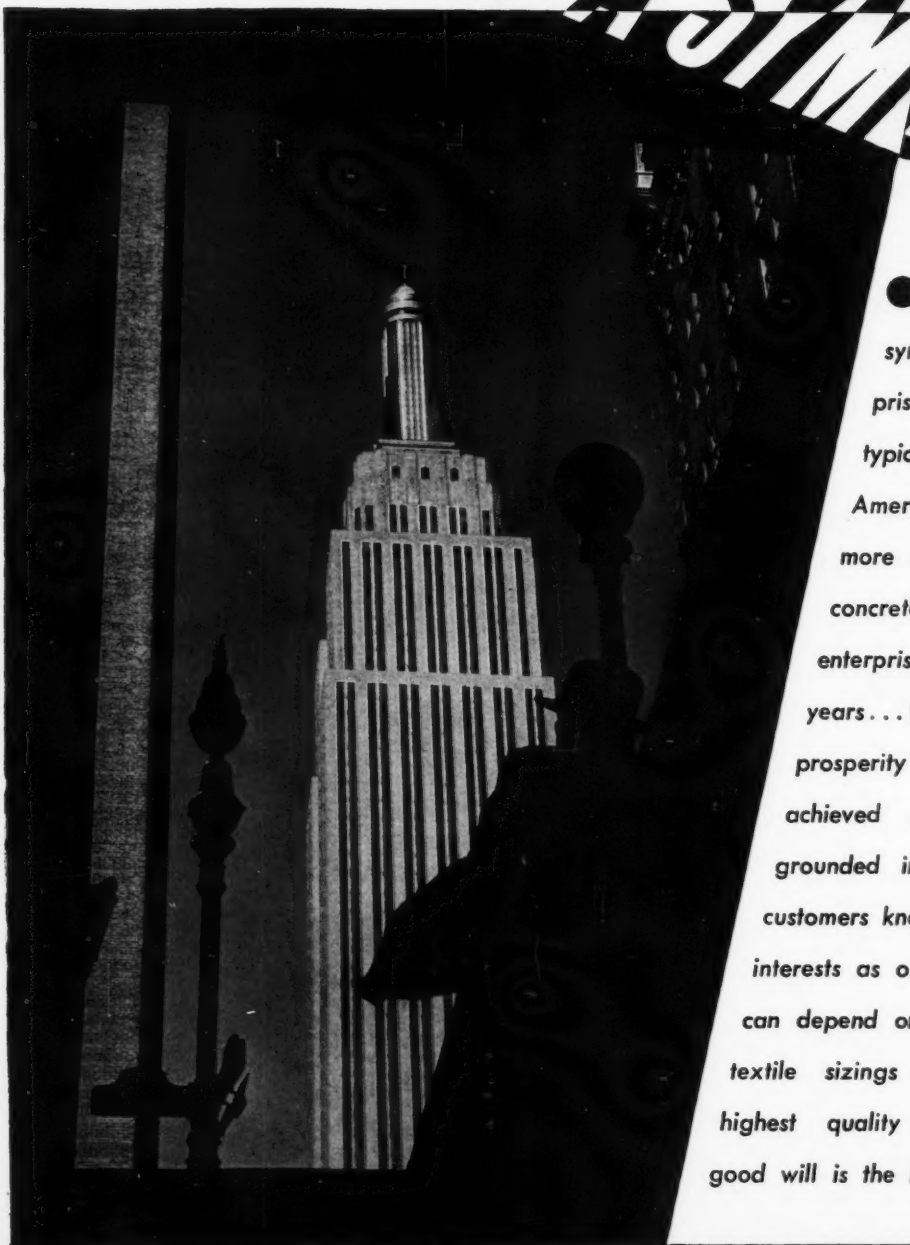

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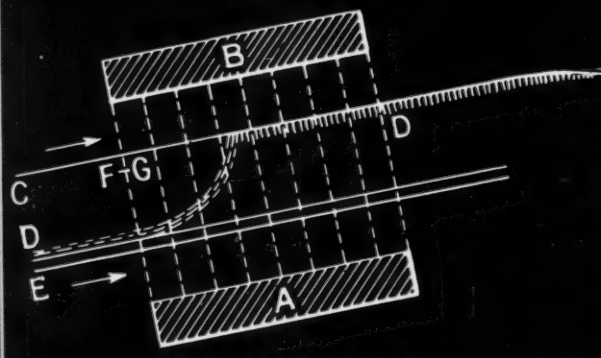
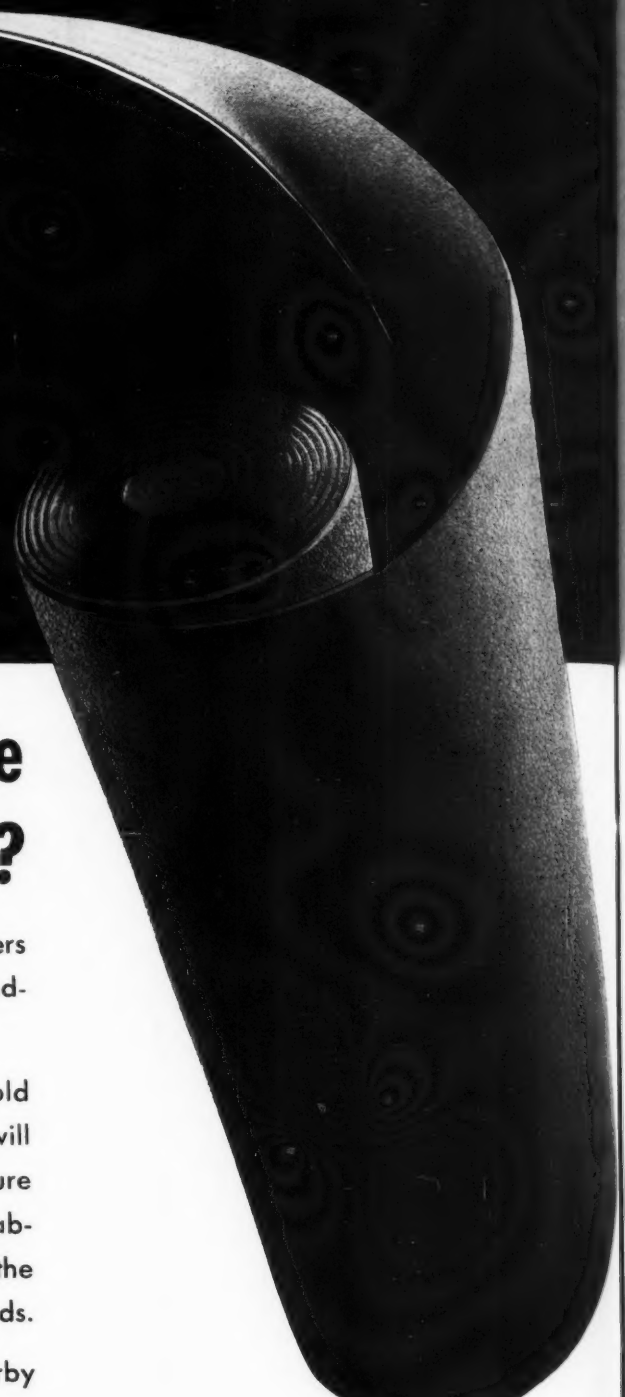


KEY TO DIAGRAM

The backing fabric, *C*, coated on the face with a suitable adhesive, passes between the negative electrode, *A*, and the positive electrode, *B*. The cut fibers, *D*, are carried on the conveyor belt, *E*. Entering the electrostatic field between the two electrodes, the cut fibers first rise and stand on end with their long axes parallel to the lines of electrical force *F-G*, and then are propelled at high speed toward the positive electrode.



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DYESTUFF REPORTER

VOLUME 31 MARCH 2, 1942 NUMBER 5

OXIDATION OF WOOL KERATIN
by Potassium Dichromate*

RUTH O. DONOHUE and RACHEL EDGAR

From the Sections of Home Economics (Textiles and Clothing) and Chemistry, Iowa Agricultural Experiment Station

The effect of a mordanting bath's acidity on plain-woven wool, prepared with benzene and saponin or with soap and naphtha, has been measured by determination of the mordanted wool's ash, chromic oxide, weight, total nitrogen, total sulfur, sulfate sulfur, and wet strength after one hour at 100° C. in fifty volumes of water or potassium dichromate, three per cent the weight of the wool and 0.0000 to 0.5000 *N* as to hydrochloric acid.

The mordanted wool's ash, equivalent to chromic oxide computed from chromium, and weight each attained a maximum at 0.0200 *N* hydrochloric acid but decreased with increasing concentration of acid.

The wool's sulfate sulfur was removed with soap and naphtha and that of wool prepared with benzene and saponin was lowered to less than 0.1 per cent by mordanting except in the bath 0.0200 *N* as to hydrochloric acid; none of the mordanted wools increased in sulfate sulfur.

The wool's wet strength decreased more rapidly than its nitrogen or non-sulfate sulfur though values for these constituents of wool mordanted in a bath 0.0200 *N* as to hydrochloric acid are approximately those of the water-treated wool (Table 5). The method of preparing wool for experimental use appears to influence its degradation by acidic potassium dichromate since the ratio of nitrogen to non-sulfate sulfur decreases with increasing concentration of acid for wool prepared with soap and naphtha but remains constant between 0.1500 and 0.3500 *N* hydrochloric acid for wool prepared with benzene and saponin.

MERCER in 1839 noticed that potassium dichromate greatly increased wool's affinity for dye and otherwise affected wool like chlorination[51]. Since then the protection alkali dichromates provide wool has been stressed in the literature but with few quantitative data. These data for fixation of mordant and strength of mordanted wool often are difficult of interpretation and generally are not comparable because different wools of different preparation and content of moisture have been tested, because the sorbed chromium has sometimes been measured by a direct and sometimes by an indirect method, because the mordanting baths have not been definitely described as to whether their compositions were based on weight of wool or volume or weight of solvent or solution, and because analyses have sometimes been expressed in terms of the original wool and sometimes in terms of the mordanted wool.

The superiority of the alkali dichromates over other compounds of chromium as mordants for wool and the optimal ratio of 0.03 gram of potassium dichromate per gram of wool have been recognized for a long time[17, 57]. Although the unimpaired strength[36, 38, 40, 63] and good spinning and weaving properties[25] of chrome-mordanted wool have been emphasized, wool excessively mordanted with alkali dichromates has been described as of harsh handle[56] and low felting power[37, 39, 44] and strength[33, 23, 37, 22, 25, 48]. Processed wools have been reported as more attacked than untreated wools[45, 21] and fine wool as taking up more mordant than coarse wool[48]. Astbury noted that concentrated potassium dichromate in two minutes destroyed hair's property of being set in the β-form but that prolonged washing restored this setting power[4].

Haller has stated that wool exerts no reducing action on potassium dichromate[28, 29] and Bedu that the low strength of some chromed wools is not due to the oxidizing action of this dichromate[13]. On the other hand, Scurati-Manzoni stated that wool's sulfur was oxidizable to sulfate by potassium dichromate[55] as suggested by Nietzki[43]. Recently the high sorption of chromium by irradiated wool has been ascribed to its reduction of potassium dichromate[53]. It has also been suggested that potassium dichromate's destructive action on wool may result from attack at its disulfide bonds[41, 44].

Alkali dichromates have been used for mordanting wool, hair, and fur for the printing of dye, for dyeing wool by the chrome mordant, metachrome, and afterchrome processes, for the production on wool of chromium pigments such as Mineral Khaki[54, 2], for the stripping of dye from wool[21, 60, 30], for felting wool, and for making wool more resistant towards bacterial attack[35, 16, 34, 26], heat[59], water, light, and weathering[53].

*Journal Paper No. J-918 of the Iowa Agricultural Experiment Station, Ames, Iowa. Project 539.

EXPERIMENTAL PROCEDURE

Preparation of Wool

The woolen fabric was woven plain, at the Biltmore Industries, Inc., Asheville, N. C., of carbonized* New Zealand wool and Australian tops, 3.3 inches in mean length, lubricated with an emulsion of lard oil, glycerol, borax, and hot water. This unscoured cloth contained 7.5 per cent of naphtha-extractable material but no sulfite sulfur[24] nor selenium[20].

A. For the first series of mordantings fifteen grams of unraveled strips for breaking strength or five three-gram samples of wool were extracted continuously for twenty hours with sulfur-free benzene in a Soxhlet extractor and dried in air at room temperature before[12] they were washed once for five minutes in 100 volumes of 0.1 per cent saponin at 40° C., rinsed continuously five times with water at room temperature, dried, again extracted continuously for twenty hours with benzene, dried, rinsed continuously eight times in water, and again dried at room temperature[19].

B. For the second series of mordantings the wool was prepared by washing 100-gram samples fifteen minutes at room temperature in eighty volumes of 0.5 per cent olive-oil soap[7] (Table 1) in a white enameled pan, rinsing

TABLE 1
Analysis of Soap

Acid number of fat acids, *milligrams of potassium hydroxide per gram of air-dry fat acids*	197.8	(0.2*)
Alcohol—insoluble material	none	
Anhydrous soap, *percentage of air-dry soap*	98.3	(0.4)
Combined alkali, *sodium oxide as percentage of air-dry soap*	9.92	(0.04)
Free acid	none	
Free alkali	none	
Material volatile at 105° C., *percentage of air-dry soap*	0.8	(0.1)
Titer, °C.	12.9	(0.1)
Unsaponified and unsaponifiable matter	none	

*Mean deviations of three parallel determinations are within parentheses.

the wool in eighty volumes of water for fifteen minutes at room temperature, and repeating this entire procedure twice before steeping the wool in eighty volumes of water for fifteen hours at room temperature. The residual wool was then dried at room temperature, cut into strips weighing fifteen grams for 24 hours' continuous extraction with naphtha (*Skelly D* of boiling range 77° to 115° C.) in a Soxhlet extractor, dried at room temperature, rinsed continuously eight times in water, and dried again at room temperature.

The wool prepared by these two methods is described in Table 2.

TREATMENT OF WOOL WITH POTASSIUM DICHROMATE

Fifty milliliters of water per gram of wool or a fifty-volume bath of potassium dichromate, three per cent the

*It is regrettable that the authors did not use uncarbonized wool for their experiments. The carbonization process alone so alters the chemical nature of wool fiber that results obtained when carbonized wool is used, in any series of experiments, are frequently not comparable with results obtained when uncarbonized wool is used.—EDITOR.

TABLE 2
Analysis of Plain-Woven Wool

Determination	Preparation of Fabric: A. With Benzene and Saponin	B. With Soap and Naphtha
1. Ash, *percentage of fabric*	0.09 (0.00*)	0.15 (0.00)
2. Breaking strength, *pounds per inch*		
Warp		
Conditioned	34 (1)	37 (1)
Wet	21 (1)	24 (1)
Filling		
Conditioned	34 (2)	33 (2)
Wet	23 (1)	22 (1)
3. Chromium	none	none
4. Distribution of yarns in fabric		
Number per inch		
Warp	32 (1)	34 (0)
Filling	27 (0)	30 (1)
Percentage by weight of fabric		
Warp	52.6 (0.6)	53.1 (1.6)
Filling	47.3 (0.3)	47.0 (1.0)
5. Elongation of fabric at breaking load, *percentage*		
Warp		
Conditioned	51	61
Wet	74	77
Filling		
Conditioned	42	54
Wet	66	71
6. Nitrogen, *percentage of fabric*	17.13 (0.03)	16.80 (0.03)
7. Selenium	none	none
8. Sulfur, *percentage of fabric*		
Non-sulfate sulfur	3.49	3.57
Sulfate sulfur	0.30 (0.01)	none
Sulfite sulfur	none	none
Total sulfur	3.79 (0.02)	3.57 (0.01)
9. Thickness of fabric, *0.001 inch*	19.5 (0.4)	19.5 (0.6)
10. Twist of yarn, *number per inch, direction*		
Warp	11 (1) Z	10 (1) Z
Filling	11 (2) Z	11 (2) Z
11. Weight of fabric, *ounces per square yard*	9.63 (0.25)	10.59 (0.11)
12. Yarn number, *typp*		
Woolen warp	4.19 (0.02)	4.33 (0.07)
Woolen filling	4.05 (0.22)	3.83 (0.04)

*Mean deviations are within parentheses.

weight of the wool and 0.0000, 0.0200, 0.1500, 0.2500, 0.3500, or 0.5000 *N* as to hydrochloric acid, were measured into a 500-milliliter Erlenmeyer flask fitted with a water-cooled reflux condenser and maintained for thirty minutes in a boiling water bath before a sample of wool, prepared with benzene and saponin or with soap and naphtha and dried to constant weight in an electric oven at 105° to 110° C., was wet thoroughly in fifty volumes of water to insure level mordanting, squeezed as dry as possible, and immersed in the mordanting bath. After one hour the wool was removed, rinsed for five two-minute periods in fifty-volume baths of water at room temperature, and dried at room temperature.

A solution of nearly normal hydrochloric acid was prepared and standardized against sodium carbonate using Methyl Orange as indicator; a calculated volume of this acid was added from a buret to each mordanting bath.

The calculated volume of potassium dichromate, nearly 0.03 *N* and standardized [27b] against iron wire of known purity using potassium ferricyanide as outside indicator, was also measured from a buret into each mordanting bath.

WEIGHT AND ASH

A three-gram sample of residual wool was dried at 105°

to 110° C. in an electric oven until constant in weight and ignited in a porcelain crucible at the dull red heat of an electric muffle furnace until constant in weight. Each weighing was made with a tare and the values for weight and ash of wool are the means of five parallel determinations based on the weight of the prepared wool dried at 105° to 110° C.

Chromic Oxide

The crucible containing the wool's ash was placed in a 400-milliliter beaker which was covered with a watch glass during the addition of forty milliliters of 6 *N* sulfuric acid before rinsing the crucible with 105 milliliters of water. Five milliliters of six per cent potassium permanganate were added to this solution which was vigorously boiled for twenty minutes on an electric hot plate. The walls of the beaker were rinsed down with hot water and fifty milliliters of concentrated ammonium hydroxide before digestion on a hot plate, forty milliliters of 6 *N* sulfuric acid were added, the solution was heated to boiling, and filtered. After cooling the filtrate was made up to 500 milliliters and 100-milliliter aliquots were titrated; to one aliquot 25 milliliters of a standard solution of ferrous ammonium sulfate were added and the excess of the latter after five minutes was titrated with standard potassium dichromate using potassium ferricyanide as outside indicator[27c]. The values for chromium, expressed as chromic oxide, are the means of five parallel determinations and are based on the weight of the prepared wool dried at 105° to 110° C.

Nitrogen

A three-gram sample of residual wool was converted into a colorless solution by fifty milliliters of boiling concentrated sulfuric acid containing a drop of mercury and ten grams of anhydrous sodium sulfate. After cooling and dilution with 200 milliliters of water, a small piece of paraffin, 160 milliliters of forty per cent sodium hydroxide, twenty milliliters of ten per cent potassium sulfide, and a few small pieces of zinc were added, the mixture was at once distilled into a measured volume of standard hydrochloric acid, and the excess of acid was titrated with standard sodium hydroxide, using Methyl Orange as indicator. Each value for nitrogen by this Kjeldahl method[27a] is the mean of five parallel determinations, corrected by blank determinations and based on the weight of the prepared wool dried at 105° to 110° C.

Total Sulfur

A three-gram sample of residual wool was dissolved in 100 milliliters of a solution, one part nitric acid and two parts water, in a casserole on a steam plate. After the addition of 100 milliliters of Benedict-Denis reagent[18] the solution was evaporated to dryness and its residue heated to dull red for ten minutes, dissolved in 100 milliliters of ten per cent hydrochloric acid, and filtered. The filtrate was diluted to 375 milliliters, heated to boiling, and constantly stirred during the dropwise addition of 25 milliliters of ten per cent barium chloride. The precipitate was digested for fifteen hours on a steam bath, filtered into a Gooch crucible, washed free of chloride, dried in an electric oven at 105° to 110° C., and then ignited in an electric muffle furnace at 600° to 800° C. for twenty-minute periods until constant in weight. Sulfur of the reagents was estimated in three parallel determinations. Each value for total sulfur is the mean of five parallel determinations, based on the weight of the prepared wool dried at 105° to 110° C.

Since the Benedict-Denis method for estimation of organic sulfur[18] was applied to proteins by Hoffman and Gortner[32] and to wool by Barritt[11] there have been reports of its unreliability for proteins containing methionine[49, 50, 42, 46]. Because wool has been described as containing from 0.1 to 0.6 per cent of methionine[49, 6, 12, 10, 5] the Benedict-Denis method has been compared with the Parr Bomb procedure. A finely divided half-gram sample of wool, prepared by treatment with soap and naphtha, was dried until constant at 105° to 110° C. before mixture with fifteen grams of sodium peroxide, one gram of potassium perchlorate, and 0.2 gram of benzoic acid for ignition in a Parr Bomb over a low pointed flame[52]. The residue from this ignition was dissolved in thirty milliliters of concentrated hydrochloric acid and diluted to 400 milliliters before determination of its sulfate as described before. Four determinations with the Parr Bomb averaged 3.53 ± 0.01 per cent; four parallel determinations by the Benedict-Denis method averaged 3.57 ± 0.01 per cent. This difference between the two means, in reverse order to that obtained by Larose and Tweedie[42], is within experimental error. The Benedict-Denis method was adopted for this study because with it larger samples might be used.

Sulfate Sulfur

A three-gram sample of wool was dissolved in fifty milliliters of thirty per cent hydrochloric acid in a boiling water bath[47], this solution was cooled, diluted with fifty milliliters of water, filtered, and brought to boiling before precipitation of its sulfate as described before. Each value for sulfate sulfur is the mean of five parallel determinations, corrected by blank determinations and based on the weight of the prepared wool dried at 105° to 110° C.

Breaking Strength and Elongation at Breaking Load

Strips of each prepared wool, raveled to one inch, twenty from the warp and twenty from the filling direction of the fabric, were conditioned 24 hours at 70 ± 2° F. and 65 ± 2 per cent relative humidity before testing with a Scott Universal Tester and autographic recorder. A like number of strips of each wool was immersed in water at room temperature for two hours, withdrawn singly, and tested wet at once. Ten warp specimens of prepared wool were raveled to one inch, mordanted in a fifty-volume bath (based on the conditioned weight of the wool), rinsed, and tested after immersion for one hour in fifty volumes of water. Actual elongation at breaking load was measured to one-ninth inch on the stress-strain curve traced by an autographic recorder[1b].

Analysis of Prepared Fabric

The values reported are the means of three parallel

TABLE 3

Effect of Fifty Volumes of Potassium Dichromate in One Hour at 100° C. on the Ash, Chromic Oxide, and Weight of Wool Prepared with A, Benzene and Saponin, and with B, Soap and Naphtha

—Mordanting Bath—				Mordanted Wool					
				Ash		Chromic Oxide		Weight	
Potassium Dichromate Percentage of Wool	Hydrochloric Acid Normality	By Wool A Percentage of Chromic Oxide	By Wool B Percentage of Chromic Oxide	Of Wool A Percentage of Wool	Of Wool B Percentage of Wool	Of Wool A Percentage of Wool	Of Wool B Percentage of Wool	Of Wool A Percentage of Wool	Of Wool B Percentage of Wool
0	0.0000			0.06 (0.00*)	0.07 (0.01)	None	None	99.1 (0.1)	99.2 (0.0)
3	0.0000	52	37	0.88 (0.02)	0.61 (0.00)	0.08 (0.01)	0.58 (0.01)	99.8 (0.0)	99.6 (0.0)
3	0.0200	84	84	1.34 (0.01)	1.32 (0.01)	1.30 (0.03)	1.30 (0.01)	101.4 (0.1)	101.1 (0.1)
3	0.1500	34	38**	0.53 (0.01)	0.59 (0.02)	0.52 (0.02)		99.9 (0.2)	98.8 (0.1)
3	0.2500	27	23	0.43 (0.01)	0.35 (0.02)	0.42 (0.02)	0.36 (0.02)	98.3 (0.2)	97.2 (0.1)
3	0.3500	21	15**	0.32 (0.01)	0.24 (0.02)	0.32 (0.01)		97.8 (0.1)	96.0 (0.1)
3	0.5000	14	8**	0.20 (0.02)	0.13 (0.01)	0.21 (0.02)		96.9 (0.2)	94.1 (0.1)

*Mean deviations are within parentheses.
**Computed from ash.

TABLE 4

Effect of Fifty Volumes of Potassium Dichromate in One Hour at 100° C. on the Total Nitrogen, Total Sulfur, Sulfate Sulfur, and Wet Strength of Wool Prepared with A, Benzene and Saponin, and with B, Soap and Naphtha

Mordanting Bath		—Mordanted Wool—								
		Nitrogen		Total Sulfur		Sulfate Sulfur		Non-Sulfate Sulfur	Breaking Strength of Wet Warp	
Potassium Dichromate Percentage of Wool	Hydrochloric Acid Normality	Of Wool A Percentage of Wool	Of Wool B Percentage of Wool	Of Wool A Percentage of Wool	Of Wool B Percentage of Wool	Of Wool A Percentage of Wool	Of Wool B Percentage of Wool	Of Wool A Percentage of Wool	Of Wool A Pounds Per Inch	Of Wool B Pounds Per Inch
0	0.0000	17.09 (0.03*)	16.79 (0.02)	3.75 (0.01)	3.53 (0.03)	0.24 (0.01)	None	3.51	24 (1)	22 (1)
3	0.0000	16.98 (0.03)	16.48 (0.04)	3.57 (0.03)	3.43 (0.01)	0.09 (0.00)	None	3.48	22 (1)	22 (1)
3	0.0200	17.09 (0.03)	16.72 (0.04)	3.73 (0.02)	3.51 (0.02)	0.31 (0.01)	None	3.42	21 (0)	22 (1)
3	0.1500	16.84 (0.01)	16.22 (0.03)	3.48 (0.03)	3.47 (0.02)	0.08 (0.00)	None	3.40	19 (1)	18 (1)
3	0.2500	16.46 (0.02)	15.84 (0.04)	3.40 (0.03)	3.42 (0.03)	0.07 (0.00)	None	3.33	19 (1)	17 (1)
3	0.3500	16.23 (0.03)	15.45 (0.03)	3.37 (0.01)	3.40 (0.01)	0.07 (0.01)	None	3.30	18 (1)	15 (1)
3	0.5000	15.79 (0.03)	15.09 (0.03)	3.30 (0.02)	3.44 (0.03)	0.07 (0.01)	None	3.23	15 (0)	13 (1)

*Mean deviations are within parentheses.

determinations for weight[1a], four for yarn number and distribution of yarns by weight, five for yarns per inch[1a] and ten for length of fiber, thickness of fabric, and twist of yarn[1c] by methods described in detail elsewhere[7].

DISCUSSION OF RESULTS

Exhaustion of the mordanting bath decreased with increasing acidity beyond 0.0200 *N* hydrochloric acid (a concentration but slightly less than stoichiometric) and was little affected by the preparation of the wool (Table 3).

The lower values for nitrogen, total sulfur, and non-sulfate sulfur (Table 4) for wool treated with aqueous potassium dichromate, compared with wool treated with water, are doubtless caused by alkali formed during mordanting[62, 3, 13].

Although oxidized wools have been described as gaining in sulfate sulfur[31, 14, 61, 58] the sulfate sulfur of this wool was in no case increased by treatment with potassium dichromate which in this respect behaved like aqueous and acidic permanganate[9].

Wet rather than dry strength has been used as a measure of mechanical performance since the former is lower and more affected by change.

The wool prepared with soap and naphtha and treated with fifty volumes of mordanting solution is contrasted in Table 6 with a wool boiled in water and dried at room temperature before extraction with anhydrous diethyl ether and immersion in approximately twenty volumes of dilute hydrochloric acid at 100° C. for one hour[8]. These data suggest that potassium dichromate protects wool against rapid loss of wet strength when boiled with dilute acid although wool's non-sulfate sulfur is somewhat lowered.

(Concluded on page 123)

TABLE 5

Effect of Fifty Volumes of Potassium Dichromate in One Hour at 100° C. on Wool's Ratio of Nitrogen to Non-Sulfate Sulfur

Mordanting Bath		Ratio of Nitrogen to Non-Sulfate Sulfur	
Potassium Dichromate Percentage of Wool	Hydrochloric Acid Normality	In Wool A	In Wool B
0	0.0000	4.87	4.76
3	0.0000	4.88	4.80
3	0.0200	5.00	4.76
3	0.1500	4.95	4.67
3	0.2500	4.94	4.63
3	0.3500	4.94	4.54
3	0.5000	4.89	4.38

TABLE 6

The Protection Which Potassium Dichromate, Three Per Cent the Weight of the Wool, Provides It During One Hour at 100° C. in Hydrochloric Acid

Hydrochloric Acid	Nitrogen		Non-Sulfate Sulfur		Weight		Wet Strength	
	Wool	Mordanted Wool	Wool	Mordanted Wool	Wool	Mordanted Wool	Wool	Mordanted Wool
Normality	Percentage of Value for Blank Determination							
0.2500	95.2	94.3	100.0	94.9	96.7	98.0	57	77
0.5000	88.6	89.9	97.9	92.0	92.4	94.9	14	59
0.7500	81.5		97.9		85.8		*	

*Of no measurable wet strength.

The Water Absorption by TOWELS

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INTRODUCTION

Review and General Considerations

IN developing a method for measuring the water absorption by towels one should not lose sight of the purpose of such a method. What one is looking for is some indication of the value of the fabric as a drying agent due to its absorption of water through contact with the object being dried. The ideal method of test is one which duplicates exactly the conditions of service. This is not often easily attained but one should at least attempt to simulate service conditions as closely as possible.

In measuring the water absorption by towels there are three factors, not altogether independent of one another, which might be considered, namely, the surface tension effect on which depends the ease with which the material is wetted; secondly, the capillary action which depends to some extent on surface tension but which is also affected by the size of the fibers, type of yarn, construction of the fabric, etc., and thirdly the amount of water absorbed. From the practical point of view of service what one wants to know is the amount of water that can be absorbed by the towel and the ease or rapidity with which that water is absorbed.

Most of the methods proposed for measuring the water absorption by towels do not give that information. For example, the methods wherein the material is immersed in water and the excess water removed under certain definite conditions give no indication of the rapidity of wetting under normal conditions of use. Moreover, the amount of water absorbed and measured is too large and on the whole the experimental conditions are too far removed from the actual conditions of use. So with the methods in which the rise of water along a strip of cloth is followed and measured. This is purely a capillary action and not well suited to the determination of the amount of water absorbed in a certain time. The conditions, as for the other methods, are not at all comparable with service conditions.

In use, towels are generally applied against the object to be dried with a certain pressure. The towel is not immersed in any liquid but is pressed against the object covered with a film of water which is fairly thin in most cases. Rubbing in itself would not affect the absorption since its purpose is merely to cause various areas of the towel and object to come in contact and ensure a more efficient and rapid drying by allowing the dry sections of the towel to contact the wet portion of the object being dried.

This paper describes a method for measuring the water absorption by towels and towelling and gives the results obtained by this method for a number of commercial products. The work was undertaken for the Canadian Government Purchasing Standards Committee with the aim of finding a suitable method to differentiate good from bad towels as regards their water absorption and also as a co-operative effort for Subcommittee A-6, Committee D-13 of the A.S.T.M. A preliminary report was presented to that Committee at the October, 1938, meeting but this paper contains additional remarks and is presented for the information of all those interested in this subject.

In view of these considerations a method in which the towel, or towelling, is brought into contact with a wetted surface was thought to be worth investigation.

METHOD

The first method tried made use of an arrangement in which the cylindrical portion of an alundum thimble was covered with a thin leather strip, the parts of the thimble not so covered being made impervious to water by means of wax. The thimble was connected to a water reservoir by means of a tube passing through a cork closing the end of the thimble. The pressure of the water in the thimble could be adjusted by varying the height of the water in the reservoir. This pressure was so adjusted that water just seeped through the leather and covered it with a thin film. However, it was found difficult to obtain consistent results due to changes taking place in the leather and making it difficult to maintain a constant film of water on its surface.

The next method which was studied consisted essentially of a circular shallow receptacle closed at the top by a porous plate fixed to it by sealing wax. The plate was of the type commonly used in laboratories for drying certain chemical products. The receptacle was connected to a reservoir as before and the pressure adjusted to give a thin film of water on the upper surface of the plate. This arrangement was unsatisfactory due to the plate not being sufficiently porous and thus not allowing the water to pass through as rapidly as the towel sample absorbed it.

The third method that was found successful was based on the same principle and resembled very closely that used by Stevenson and Lindsey (J. Home. Econ., 1926, *18*, 4. 193-198) and later by Hess and Reidheimer (Am. Dyestuff Rep., 1934, *23*, 715-6, 743). Stevenson and Lindsey used a brick thoroughly wetted by immersion in water for 1½ hours and then allowed to drain before the test. Hess and Reidheimer improved the method by using a 10-inch unglazed porcelain disk kept constantly wet by placing it

in a pan of water. Only a few results are reported in their paper which makes it difficult to judge the merits of their method.

The author used two alundum plates as the porous material, the two plates being placed one on top the other. It appeared at first that one plate did not offer sufficient resistance to the passage of the water and it was difficult to control the degree of wetness of the top surface on which the samples were placed. However, near the end of our experiments, tests conducted with only one plate gave satisfactory results as the water absorption did not appear to be dependent on the degree of wetness of the surface to the extent anticipated. Fig. 1 is a sketch of the apparatus used. Instead of simply immerging the plates (P) in a dish it was found more suitable to control the wetting of the plates by connecting the receptacle holding the plates with a constant level reservoir (R) through the tube (A) fixed in the reservoir, the interconnecting rubber tube (T) and the tube (C) fixed to the receptacle holding the plates. (B) is a base to which is fixed a brass plate (F) serving as support for the receptacle and the reservoir. (I) and (O) are the inlet and overflow pipes respectively for the reservoir. The height of the receptacle is adjustable since it can be raised or lowered by means of the threaded tube (C) and the knurled nuts (S) placed over and below the supporting plate (F) through which (C) is free to move. It was found that the right degree of wetting of the porous places was obtained when (D), the difference in height between the top of the plates and the level of the water in the reservoir, was from 1/4" to 5/16". The alundum plates (P) used were 5 inches in diameter and 3/16 inch thick and of a grade designated as Norton and Co. RA98. These plates fitted snugly into the receptacle and rested on a few thicknesses of filter paper. A finer plate RA 225 was also tried in later experiments but the coarser plates seemed to give more consistent results.

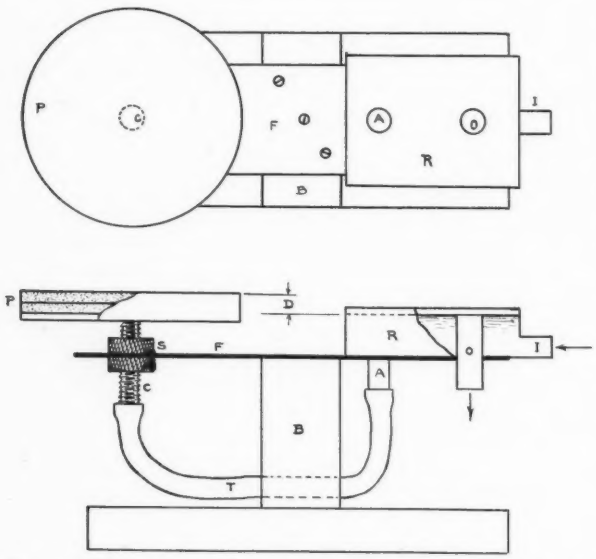

Fig. 1—Top and side views of apparatus for measuring water absorption of towel material.

PROCEDURE

In using the apparatus, the first step was to adjust the height of the plates so that these were covered with a thin film of water. This adjustment was made after allowing the plates to soak for about an hour in excess water. Once the plates were adjusted to the proper height, it was not necessary to alter this adjustment but as a precaution, the water was always turned on some time before starting a series of tests in order to allow the plates to become saturated. Distilled water was used in all tests.

A specimen 2 inches square was cut from the towel or towelling to be tested and weighed under standard conditions. The specimen was then placed on the alundum plates and immediately covered with a glass plate 3½ inches square weighing 35 grams. After an interval of time, previously decided upon, the specimen and glass plate were transferred to a tared watch glass with the glass plate covering the watch glass so as to prevent loss of moisture, and the whole weighed. The sample and plate were then put back on the apparatus and after another definite interval weighed again, this procedure being repeated until the specimen became saturated with water. The interval of time was measured of course from the time the specimen was placed on the apparatus until it was removed for weighing. The loss of any water left on the watch glass after removing the specimen was minimized by covering the watch glass with another plate between weighings. All the tests were carried out under the standard conditions of 65 per cent R.H. and 70° F.

Glass plates of differing weights were tried to determine the effect of weight as shown by the results given later but the procedure was standardized with the 35 gram plate.

RESULTS

All results will be expressed as weight of water absorbed, in grams, per gram of towel. This seemed the most logical way of measuring absorption and the results obtained fully justify this method of representing absorption.

The following table illustrates the degree of concordance obtained with three different specimens taken from the same material (sample 2) but in many cases the concordance was much better than that shown.

Table Showing Change in Weight, Due to Water Absorption, of Three Specimens of Sample 2 After One Washing by Hand

	Weight of Specimen (Gram)			
Time	*No. 1*	*No. 2*	*No. 3*	*Mean*
Initial	0.79	0.79	0.79	0.79
After 1 minute	1.29	1.36	1.45	1.37
After 2 minutes	1.58	1.60	1.76	1.65
After 3 minutes	1.86	2.08	2.08	2.01
After 4 minutes	2.14	2.46	2.39	2.33
After 5 minutes	2.47	2.86	2.70	2.68
After 6 minutes	2.78	3.26	3.04	3.03
After 7 minutes	3.11	3.64	3.36	3.37
After 8 minutes	3.45	3.96	3.73	3.71

A number of different towels were compared for water absorption in this way. These comprised ten terry towels,

of which two were colored, and one huck towel. The weight of the terry towels varied from 8.4 to 14.6 ounces per square yard. Although the construction of these samples were known, for brevity this is omitted since there was found to be no correlation between the construction of the various materials, and the water absorption.

The degree of absorption shown by the various samples and a comparison between them is best represented by graphs in which the amount of water absorbed is plotted against time.

The first set of curves, Figure 2, illustrate the effect of

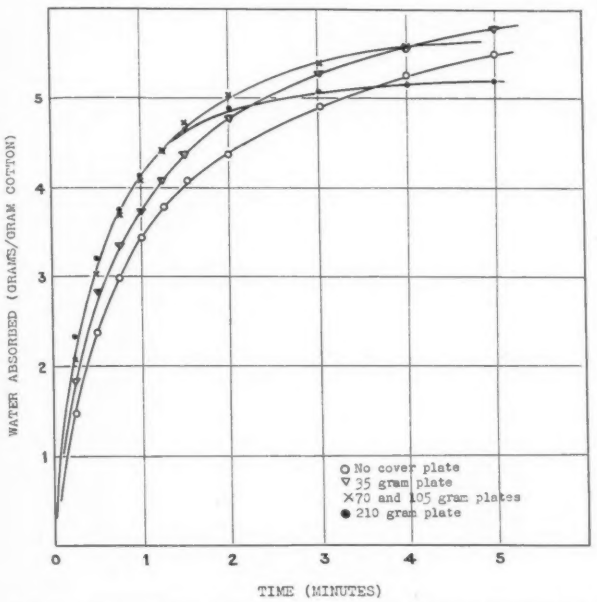

Fig. 2—Absorption of water for various weights of cover plate.

varying the weight of the glass plate placed over the specimen during test. It will be noted that the absorption with 35 grams pressure is somewhat higher at all times than when no plate is used. However, with weight of 70 grams and over, the absorption was higher than with the 35 gram weight at low values but as the fabric became saturated the extra weight was sufficient to press out some of the water from the material and the maximum absorption is lower and is reached earlier than with the smaller weight. These differences are not important from a practical point of view since, when this effect takes place, the fabric is much wetter than would normally occur in service. Although the curves are shown for one sample only (Sample 10), the same effect was found when other samples were tested in the same way.

Fig. 3 shows the effect of varying the interval of time between weighings (Sample 3). The curves diverge in regular order after 15 seconds with the smaller interval showing the highest absorption. Why this should be is not quite clear. It is probably connected with the uncovering of the porous plate at each weighing. It is possible that this allows more water to seep through the plate and results in little more water being picked up by the material, when it is replaced on the plate. Although

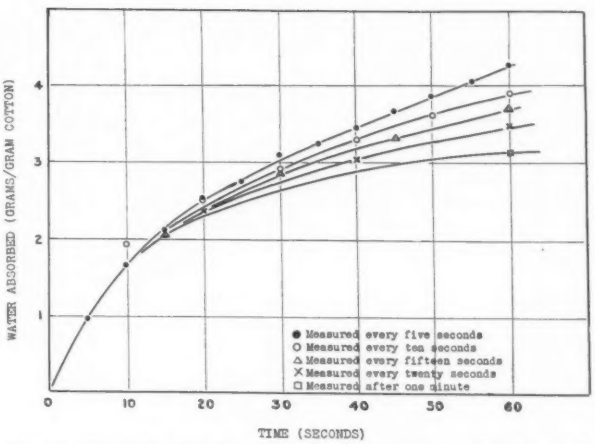
WATER ABSORBED (GRAMS/GRAM COTTON)
TIME (SECONDS)
● Measured every five seconds
○ Measured every ten seconds
△ Measured every fifteen seconds
× Measured every twenty seconds
□ Measured after one minute

Fig. 3—Variation in absorption with change in time interval.

this divergence is not very important since we are mainly concerned with the initial stages of absorption. For comparison purposes it makes it essential to standardize the conditions of test.

The effect of laundering on the water absorption for Sample 8, originally a poor material, is illustrated by the curves in Fig. 4. The hand washing referred to in the

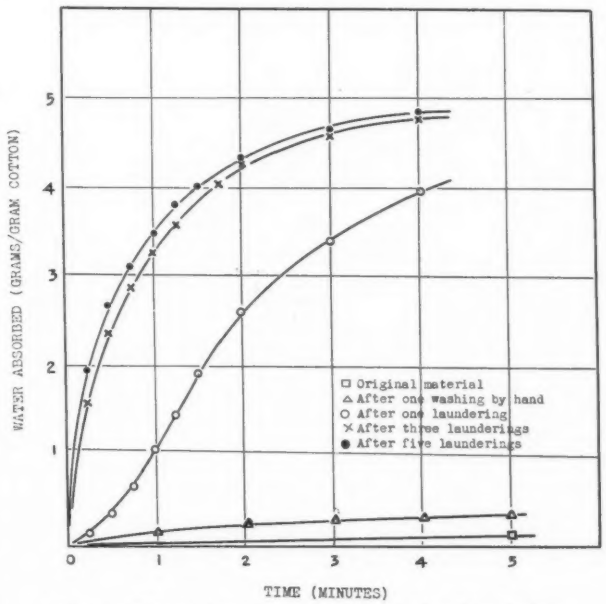

Fig. 4—Water absorption before and after laundering.

caption was simply carried out on a small sample of the material in a beaker containing a soap solution. There was only one operation followed by rinsing. The laundering operations consisted in washing the samples in a laundry wheel making use of a regular laundry sequence of four suds and four rinses followed by a sour. The results show that the water absorption is very much improved on laundering, probably due to removal of hydrophobic impurities. Three launderings appear to be sufficient to give the best absorption since the results after the fifth laundering do not differ appreciably from those obtained

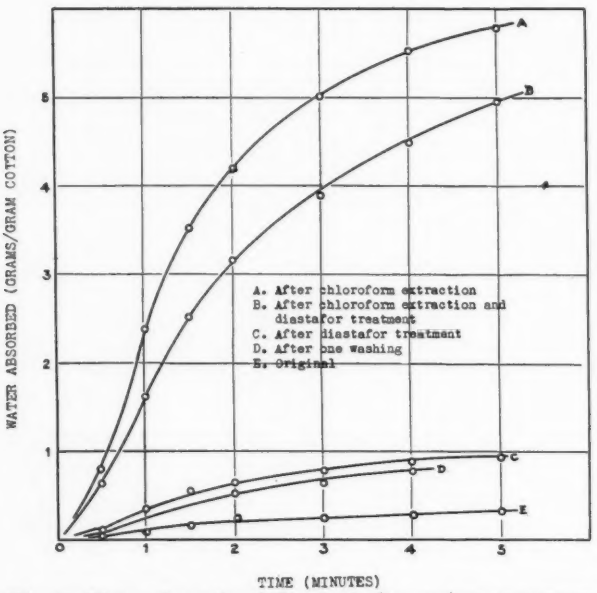

Fig. 5—Water absorption before and after various treatments (Sample 5).

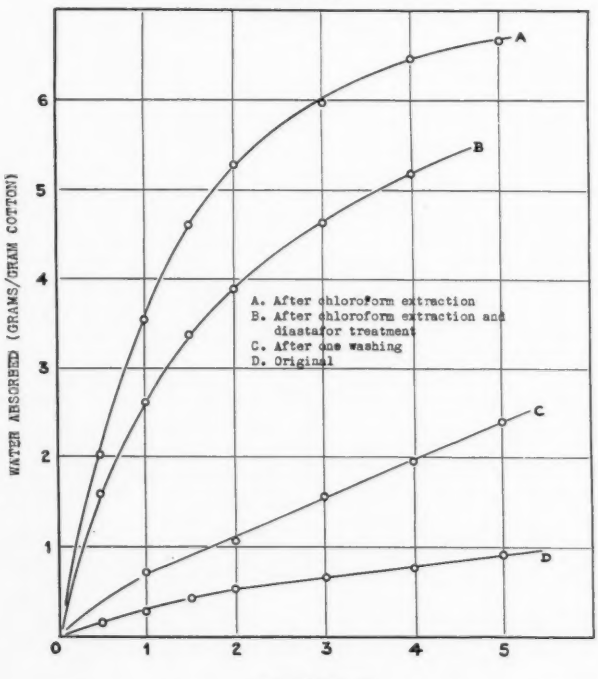

Fig. 6—Water absorption before and after various treatments (Sample 2).

after three launderings. The effect of laundering is more pronounced, of course, on such a poor material than on a material which is originally a good absorbent.

The effect of removing impurities was further investigated by subjecting samples of the towel materials to chloroform extraction, diastafor treatment, or one followed by the other, and measuring the absorption after these various treatments. The results for three different samples, Nos. 5, 2 and 10, differing originally in their water absorp-

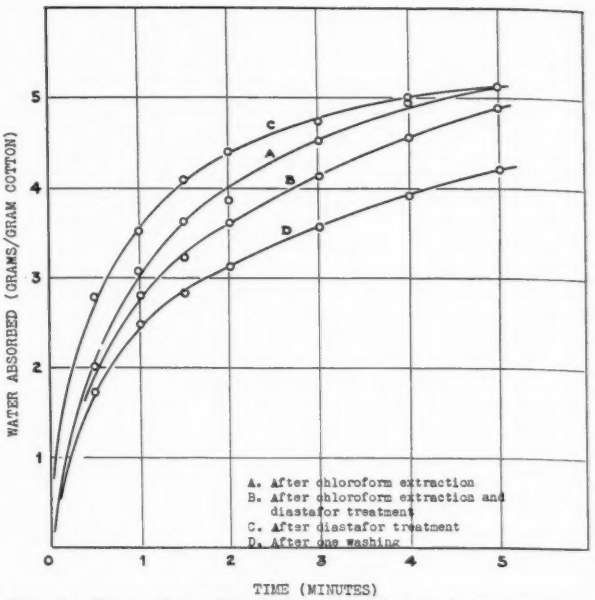
WATER ABSORBED (GRAMS/GRAM COTTON)
TIME (MINUTES)
A. After chloroform extraction
B. After chloroform extraction and diastafor treatment
C. After diastafor treatment
D. After one washing

Fig. 7—Water absorption before and after various treatments (Sample 10).

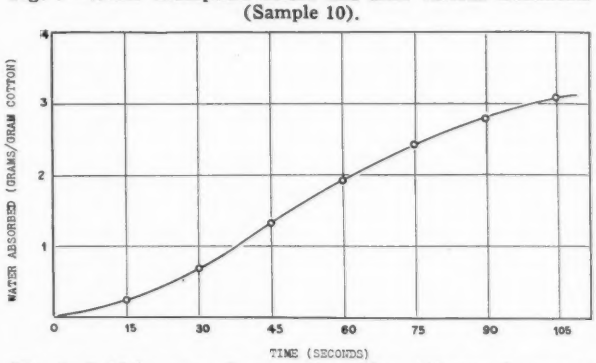

Fig. 8—Initial stages of water absorption. Measured every 15 seconds. Sample 5 after chloroform extraction and diastafor treatment.

tion, are given in Figures 5, 6 and 7 respectively. In all three, the treatments given improved the absorption of water. As was to be expected the improvement was more pronounced on Samples 5 and 2 which originally were poor absorbents than on Sample 10 which had good absorbing properties before the treatments.

Except for Sample 10, the chloroform extracted samples gave the best absorption. When the diastafor treatment followed the chloroform extraction, the absorption was diminished. The bad effect of the diastafor was also noted in many other samples where it had been used. These results seem to indicate that some hydrophobic constituent of the diastafor remains on the fabric in spite of good rinsing. They also show that the poor wetting properties of some towels appear to be due entirely to waxy constituents extractable by chloroform and also removed after a few launderings.

Fig. 8 shows the initial stages of the absorption of Sample 5 extracted by chloroform and treated with diastafor.

(Continued on page 123)

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CALENDAR of Coming Events

Meeting, New York Section, Swiss Chalet, Rochelle Park, N. J., March 27, 1942.

Meeting, Philadelphia Section, April 3, 1942.

Meeting, Northern New England Section, April 10, 1942.

Meeting, Southeastern Section, Waverly Hotel, Columbus, Ga., March 21, 1942. A round table discussion will be held.

Research Committee and Council Meetings, North Carolina State College, Raleigh, N. C., April 18, 1942.

Meeting, Piedmont Section, Sir Walter Hotel, Raleigh, N. C., April 18, 1942.

CELLULOSE ETHER

and Textile Applications*

J. ANDREW CLARK
Sylvania Industrial Corp.

IN discussing the alkali soluble cellulose ethers, it is my intention to pass lightly over their preparation, reviewing this only to the extent necessary to illustrate the relation of the ethers to the other cellulosic compounds and especially that of the alkali soluble types to the water and organic solvent types.

CHEMICAL STRUCTURE AND PREPARATION

As their name indicates these properties are actually ethers with a structure of X—O—R where X represents a cellulosic unit and R one of the various alkyl or aryl groups. Commercially, these latter groups have been restricted for the most part to methyl, ethyl, hydroxy ethyl and benzyl groups, although numerous other radicals have been used experimentally. Unlike the cellulose esters in which the cellulose replaces hydrogen in the carboxyl group of the acid, the ethers do not saponify with alkali nor caustic.

The ethers in general are prepared by the reaction of inorganic acid esters on cellulose in the presence of alkali. A second type of reaction uses ethylene oxide or chlorhydrin in the presence of alkali to form hydroxy alkyl cellulose ether. A third type makes use of mono-chlor acetic acid in presence of alkali to form a glycolate.

1. $C_6H_{10}O_5—NaOH + C_2H_5Cl \longrightarrow C_6H_9O_4—O—C_2H_5 + NaCl + H_2O$

2. $C_6H_{10}O_5—C_2H_4OH + HC(H)—C(H) \longrightarrow C_6H_9O_4—O—C_2H_4OH$ (via epoxide ring)

3. $C_6H_{10}O_5—NaOH + Cl—CH_2CH_2OH \longrightarrow C_6H_9O_4—O—CH_2CH_2OH + Na\,Cl + H_2O$

4. $C_6H_{10}O_5—NaOH + CH_2—C—O—ONa \longrightarrow C_6H_9O_4—OCH_2\,COONa + NaCl + H_2O$

Owing to the complex and poorly defined character of cellulose itself and to the fact that the glucose units of cellulose react independently of each other, stoichiometric relations between the cellulose and the etherifying agents to yield pure mono-di- or tri-ethers do not seem possible in practice. While no sharp separation of the ethers is possible based on the preparation of pure compounds, it has been observed in general that the ethers can be divided roughly into three classifications in accordance with the degree of substitution. The lower are alkali soluble, intermediate are water soluble, and highest substituted are organic solvent soluble. For example, substitution of one-half hydroxyl group per glucose unit ($C_6H_{10}O_5$) by an ethoxy group yields an alkali soluble type, substitution of one hydroxyl yields a water soluble product, and substitution of two hydroxyls yields an organic soluble type. Of course this classification is only by way of illustration, for a study of the patent literature shows considerable overlapping of these arbitrary division points, in accordance with the method of preparation and other factors. In general good alkali solubility requires about 25 per cent chlorhydrin or 13.5 per cent ethylene oxide on the weight of the cellulose. This corresponds to substitution of ½ hydroxyl group per glucose unit.

Like other cellulosic materials the ethers are unique in that their physical properties depend in great measure on the cellulosic chain length, in contrast to their chemical properties which are the summation of the average degree of etherification along the chain. Thus ethers widely different in physical properties such as viscosity and solubility may be prepared with substantially the same degree of substitution.

Various cellulosic materials have been suggested as the raw materials for ether preparation, but as yet only cotton linters and sulfite pulp are available commercially in sufficient quantities and quality to ensure uniform quality in the manufactured product. The cellulose is first converted to alkali cellulose by steeping in caustic soda to swell and make it more reactive as in the manufacture of viscose. Caustic soda is used commercially, although quaternary ammonium hydroxide and other organic bases are said to give more uniformly swollen cellulose. The cellulose : caustic : water ratio is extremely important since the degree of substitution and the speed of the reaction are regulated by this ratio. In general it is found that the lower ratios are used in preparation of the alkali soluble and water soluble types. The ratio is considerably higher for the organic solvent soluble type.

Etherification is performed in closed jacketed kettles fitted with stirrers for the most part. Shredded and aged alkali-cellulose is reacted, with the alkyl ester, ethylene oxide, chlorohydrin or mono chloracetic acid for one to two hours with stirring, following which the reaction mass is allowed to stand for 10 to 70 hours. Temperatures are controlled carefully, and when the reaction period is ended the mass is purified.

Purification and removal of the salt and caustic is of no particular interest and simply follows along conventional lines.

*Presented at meeting, Rhode Island Section, November 28, 1941.

A typical example of the preparation of an alkali soluble cellulose ether is described in Lilienfeld's U. S. Patent 1,722,927, July 30, 1939. 100 parts of sulfite cellulose or cotton linters are soaked in 1000 to 2000 parts of caustic soda solution 18 per cent, at 15° to 20° C. until uniformly saturated. It is then allowed to stand in a closed vessel for 3 to 24 hours at ordinary temperature. The mixture is then pressed or centrifuged to 350 parts and shredded. If desired the alkali cellulose may now be aged for 3 to 72 hours. The alkali-cellulose is then mixed in a vessel equipped with stirring mechanism with 30 to 60 parts of a-monochlorohydrin, either added at once or in small portions. The mixture is then stirred for ½ to 2 hours. The reaction mixture is then allowed to stand for 10 to 30 hours after which it is complete.

In preparing the ethers with ethylene oxide, closed containers are necessary, and during the reaction the pressure falls as the reaction proceeds.

When prepared for sale the ether is a white fluffy fibrous material resembling linters in appearance, which dissolves in cold dilute caustic soda to give a colorless thick and viscous solution resembling glucose or Karo Corn syrup. Six to eight per cent of ether may be dissolved in six to 10 per cent caustic at 0° to 10° C., but after solution has been once obtained it may be warmed to room temperature or above without affecting stability. Brine jacketed kettles may be used for cooling the mix in making solution, or if more feasible cracked ice may be used, replacing an equivalent amount of water in the formula.

A typical example for the preparation of a 6 per cent ether, 8 per cent caustic soda solution, by use of ice follows:

60 grams ether
580 grams water
160 grams 50 per cent caustic soda solution
200 grams cracked ice

1000 grams

Mix the ether and 580 grams of water and break any lumps. Then stir in slowly the 160 grams of caustic soda solution. The fibers will swell tremendously and become translucent. Some solution seems to take place. Then add the cracked ice at once with stirring. The temperature drops to 0° to 10° C. with the swollen fibers dissolving to give a clear transparent and sparkling solution. In the laboratory we prepare solutions simply by inserting of mixture of the ether and dilute caustic in the freezing chamber of a household refrigerator.

The viscosity of solutions of a given type of ether vary with concentration and temperature, and consequently in finishing applications we feel it advisable to use the solutions at a uniform temperature and suggest in most cases that room temperature prevailing in summer.

METHOD OF APPLICATION TO TEXTILES

These solutions find application in the textile field for the most part as so-called permanent finishes. After application to the fabric the solution must be coagulated to convert the ether to its original condition, wherein it is insoluble except in about 6 per cent to 10 per cent caustic alkali at low temperature.

Solutions can be coagulated by excess water, acid, salts, alcohol or ammonia. When applied to the fabric we have an additional means of coagulation available in drying out one-half or more of the water, and in addition with some types of ethers we can coagulate by passing the treated cloth through caustic of mercerizing strength.

The application of alkali soluble cellulose ether solutions for the production of permanent finishes on cloth requires two steps. First impregnation and second coagulation, followed by washing, drying and the other usual finishing operations. The solutions may be applied in conventional equipment such as pads, mangles, back fillers, spreaders and quetches, except that the use of brass, copper and other metals soluble in caustic must be avoided. The ether coagulates on the surface of such metals, then breaks loose and adheres to the cloth in the form of scabs or patches. Stainless steel, Monel, steel and rubber are satisfactory for use in the rolls or other equipment coming in contact with the alkaline ether solutions.

The solutions are quite slippery and consequently it is advisable to have the top and bottom rolls of pads or mangles geared together or supplied with other means for positive drive of both bowls especially when working with solution of 3½ per cent ether or above.

Medium to medium-hard rubber rolls (22-35 Plastometer) with good set seem to work best and give better penetration, whereas with softer rolls there is a tendency for the cloth to permit excess surface liquid to pass the nip, especially when unscoured grey cloth is padded. Grey and bleached cloth run under the same conditions through the nip may permit the grey to come through soaking wet, while the bleached cloth would have good penetration and no excess solution on the surface. The ether, unlike other finishes, may be applied at any convenient step in the bleaching or finishing procedure, as the usual bleaching operations such as kier boiling and scouring have practically no effect in removing it once it is coagulated. This will be illustrated later in our discussion of the various fabrics treated commercially.

As mentioned, coagulation consists simply of making the ether already applied to the fabric insoluble by one of several methods. The simplest and frequently most convenient is to neutralize the caustic with acid. The cloth is passed at width or in rope form into acid of from 2 per cent to 10 per cent, after which it is washed and neutralized, if desired, with soda ash, ammonia or other mild alkali. For certain finishes the cloth may be dried or partially dried on a frame at low temperature, following which the caustic may be removed with hot water. A third method of coagulation makes use of caustic of 50° Tw. or over to insolubilize the special type of ether made for this use. This method is showing considerable promise in the mercerized shirting field, since convenience of operations results in little added cost for the materials

used. As is well known, several established lines of sheets and pillow cases, table damask, printed fabrics, and other types have been finished with alkali soluble ethers commercially for several years. The following are some comments regarding various fabrics, and more uses are being developed steadily, including fabrics for use by the Army and other governmental departments.

APPLICATION TO VARIOUS FABRICS

Wide Sheeting

This has been finished in several constructions, especially the 64 x 64 quality, which is probably the largest volume item in such merchandise. One plant pads the dry kier boiled cloth with 4 per cent ether solution at 125 yds. per minute. The cloth is then dropped into a J shute and pulled through a long, narrow, horizontal acid box to coagulate the ether. It was found that one pass through a sour pit of this type was more effective than the results obtained with a more conventional sour machine. The flopping of the cloth in the long box allows acid to get in all the folds of the wide sheeting during passage of the cloth through it. The cloth is then washed, bleached and finished as usual with the exception that only softeners and tint are applied in finishing. These goods have been subjected to the most severe tests, and have always shown remarkable retention of finish after twenty or more commercial launderings.

Results are equally satisfactory with other qualities.

In many plants, it is most convenient to treat the grey cloth. Application of 2 to 3 per cent of the ether to dry, singed, grey carded percale sheeting followed by acid coagulation, washing and peroxide bleaching gave very pleasing results. Curiously, cloth treated in the grey was then bleached with peroxide to a sparkling clear white, whereas we did not obtain as clear a white with the usual hypochlorite bleach in this instance. However, hypochlorite bleach is the usual practice when the cloth has been boiled off before applying the ether.

Damask Table Tops and Napkins

Application of alkali soluble cellulose ethers to jacquard table damask has been widely used for several years, not only as a permanent finish but also for its non-linting qualities. Five to 5½ per cent is applied to the mercerized kier boiled cloth either before or after bleaching. The cloth is acid coagulated, preferably at width to avoid creases, then washed, neutralized, tinted, dried and flat calendered. If desired, a Schreiner finish may be applied. One concern, which conducted extensive experimental work reported that they found it made very little difference whether they applied the ether to the boiled off dry cloth before or after mercerizing.

An interesting phase of this development is that a large linen supply house found that after all their stock was treated with cellulose ether, starching in the laundering could be entirely eliminated with a continuing saving during the entire life of the table cloths and napkins.

Print Cloth

Considerable yardage has been run in the lower counts, where the application of either has been found of particular advantage. Mineral fillers applied in either a mangle or backfiller offer possibilities in building up the appearance of the lower counts to that of a better quality. If not added in excessive amounts, clay or talc dispersed in the ether will resist repeated launderings. If the clay or talc mixture is applied before printing, very fine sharp lines may be printed from shallow engravings.

In treating these constructions it is usually found advantageous to apply 2 to 2½ per cent ether to the grey cloth after singeing. This enables the deposited film to receive the maximum amount of mechanical breaking, which results in a soft full hand. Applied after bleaching, the cloth would be somewhat wiry, thready and hard.

Shirting

An interesting development in shirtings relates to the use of cellulose ether coagulated by the caustic of the mercerizing range. A very substantial yardage of shirting has been treated in this manner. There are still a few problems relating to the process, and for the time being we are working on this project to straighten out these things. In this procedure the grey cloth is dry-singed and then saturated with 2 per cent of the special type of alkali soluble cellulose ether, applied in the first box of a mercerizer range. Following a tight squeeze on the pad the cloth enters immediately into caustic soda of approximately 50° Tw. in the second saturator box. It then passes through the conventional 3 roll mangle and to the mercerizing frame. The cloth must then be washed with hot water on the frame and in the boxes. After kier boiling the goods are washed and peroxide bleached, as a great deal of the cloth is woven with dyed yarns.

In this case the ether used must have a rather definitely limited range of solubility in order that sharp coagulation will occur, and avoid any ether getting into the caustic. This procedure eliminates extra operations by combining the application and coagulation with the usual mercerizing methods, while a further saving may be made in net yardage after Sanforizing. We have observed at least 1 per cent gain when using this treatment as compared with the usual return. Another important fact to shirt manufacturers is that after five launderings the treated shirt retains most of its original pleasing finish, condition and appearance.

Filled Cloth in England

Fabrics containing as high as 30 to 40 per cent of mineral fillers are quite commonly finished in England, mainly for export markets. In this extreme requirement, 2 to 4 per cent solution of the ether is first padded on the cloth, following which it is backfilled and then soured to coagulate the ether. By usual methods, these fillers

wash out in the first laundering, but when treated with ethers as described, they retain a considerable amount of added material through repeated washing.

Collar cloth treated in the above two step manner but without fillers was very satisfactory. After calendering or otherwise finishing this fabric the appearance of the collar was found to be slightly different in color as compared with the body of the shirt. To avoid this our English friends finished the collar cloth first, and then matched the shirting to the collar cloth. The second ether treatment was done with approximately 5 per cent to 6 per cent concentration of ether.

The war in England has caused a new use for cloth treated with ether. When German bombs destroyed glass windows, an available substitute for glass was urgently needed. The fabric containing ether lets in sufficient light, although not transparent, and of course it is amply weatherproof for this purpose. Large quantities have been used.

Insulation Cloth

It is obvious that the varnished cloth cover on wire will resist the action of moisture seepage better when treated with ether than with starch materials, as the latter are susceptible to mildewing.

Extensive testing has shown that insulation cloth finished with alkali soluble cellulose ether has superior properties to starch finished fabrics. Several experimental lots of cloth have been finished and tested, and it is anticipated that commercial use will follow when conditions are favorable.

Cloth Used by the Government

The present emergency has developed new requirements and specifications for many articles heretofore thought satisfactory. Many millions of yards of woven and tricot cloth have been bought for protection against mosquitos and other disease carrying insects. Specifications require finishes which will retain certain characteristics of the cloth after three launderings. Application of alkali soluble cellulose ether to the knitted types has been extremely helpful in establishing satisfactory shrinkage. Although the government originally specified unbleached cloth, it soon became apparent that white mosquito bars in the field could readily be detected from the air. With every part of their equipment dyed olive drab to blend with the background, it was decided to dye the netting. This is accomplished by dyeing or by use of colloidally dispersed pigments in the ether. Pigments seem more suitable than direct dyestuffs and possibly vats, since the direct colors in particular photograph white for the most part with infra-red, whereas the pigments are not distinguished from the natural coloring of the background.

The woven marquisette netting, with smaller tolerances for shrinkage, is also being finished with ethers of low viscosity. Two methods are used, one of which simply consists of acid coagulation following padding of the singed mercerized and frame dried goods. The other uses semi-drying to coagulate the ether. In this procedure, the cloth is padded and then passed directly to a frame where it is dried at low temperature. When batched on the end of the frame the cloth should be practically room temperature and slightly moist. The cloth is then soured and washed with minimum tension, opened and framed. This produces a sheer crisp fabric well within the tolerance of shrinkage set up by the government. Control of width and tensions are important before padding and in semi or full drying.

The satisfactory character of this finish on mosquito netting has resulted in the suggestion of investigating the possibility of incorporating mildew, fire and water resisting materials in the ether for treatment of heavy ducks, shelter halves and sandbag osnaburg. Of these some shelter fabric has already been finished with ether containing O.D. pigment, and after coagulation, the cloth was treated with a water proofing agent before drying. The treatment of the other two fabrics is being studied now in the laboratory.

Synthetic Fabrics

Processes have been developed by Sylvania Industrial Corp. on which patents are pending, and from time to time there has been a considerable amount of experimental work carried on in connection with the use of cellulose ethers on both spun rayon and filament rayon fabrics. In some cases the treatment has been highly effective in obtaining a full mellow hand, and tests have shown a considerable degree of shrinkage control and stabilization.

At least one concern has used the ether commercially on a substantial yardage and certain comments by these people might be of interest:

> "Heavy spun rayon twills with normal shrinkage in the order of 13 per cent, which ordinarily require two runs on the Sanforizer, can be reduced to 5 per cent or under to require only one run by using alkali soluble cellulose ethers. Ether concentrations of 1½ to 1¾ per cent have been found most suitable.
>
> "Spun rayon acetate flakes for dress goods lend themselves nicely to this finish. Shrinkages of 3 per cent and under are obtained regularly. The presence of 20 per cent to 30 per cent acetate has not interfered with the treatment since the dilute caustic has no appreciable effect on the acetate during the short time involved in padding and neutralization. White and colored effects are obtained on the acetate without difficulty."

Certain underwear fabrics and dress goods made of filament rayon have been finished with ethers and shrinkages as low as 1 per cent to 2 per cent have been obtained. Future work will include studies which may determine the best means of obtaining these favorable results with practical consistency.

A very satisfactory finish was obtained on a table damask woven entirely of cellulose acetate rayon. A

final finish similar in crispness to that of the original grey goods was desired, and this was obtained by applying 2 per cent ether in solution with about 3 per cent of caustic soda. It was reported that the finish was excellent after five launderings.

General

The initial work with alkali soluble cellulose ethers from a commercial standpoint followed the acquisition of the very extensive patent structure from Dr. Leon Lilienfeld, and it has been shown that uniform products of this type, which could readily be dissolved at low cost by the average finishing plant organization, are entirely practical. The solutions when stored under proper conditions are stable over a long period of time, and frequently have been shown to be entirely satisfactory after several months. It is interesting to note that for the first time in the history of cotton textiles, a pure finish or a backfilling can be applied to grey goods and remain in the cloth through kier boiling, bleaching and other finishing operations, as well as frequent laundering in the hands of the ultimate user.

Another highly important phase of this development has been the steady increase in demand as a result of the growth in commercial usage on various types of fabrics and in numbers of finishing plants. While standard types of equipment are used in all cases, the most economical methods are those which result from range operations and minor changes or rearrangements of equipment. However, there is now ample evidence of the successful use of the ethers to justify any nominal change to provide the desired procedures, and it has been found that once the use of the ethers has been adopted, their use has become established with satisfaction to all concerned.

In order not to encumber this paper, I have omitted specific reference to patents; but it should be noted that the alkali soluble cellulose ethers are covered by the basic patents 1,589,606, 1,722,927 and 1,722,928, and also that many of the processes which I have referred to are covered by issued patents or patents pending.

DISCUSSION

Q. Have you any explanation why the fastness should be less on the rayon than on the cotton fabrics?

A. No, I don't know. It just is. We checked by dyeing the cellulose filament and laundered the fabric more or less regularly. The finish on the rayon fabrics was less permanent than on the cotton fabrics.

Q. Have you developed any plasticizers to incorporate in the ether?

A. That, in given finishes, is solved by the usual softeners. In the final finishes we generally use softeners after treating with the ether. As a matter of fact the material itself can be plasticized with either urea or glycerine.

Q. What effect does the ether have on the strength of the fabric?

A. When we first started we were getting a ten to twenty per cent filling increase in some cases. The warp does not show much of an increase.

MEETING, NORTH CAROLINA STATE COLLEGE STUDENT CHAPTER

THE North Carolina State College Student Chapter held its first meeting of the year for the purpose of electing the following officers: George W. Funderburk, Jr., Chairman, and William R. Ivey, Jr., Secretary.

Professor A. H. Grimshaw, our advisor, gave a short talk on the purposes and advantages of the student sections of the association.

Plans were made to continue the custom of having some of the prominent textile men in this section to speak to us during the remainder of the school year.

Respectfully submitted,

WILLIAM R. IVEY, JR., *Secretary.*

WINTER MEETING, PIEDMONT SECTION

THE regular winter meeting of the Piedmont Section was held at the Poinsett Hotel, Greenville, South Carolina, January 24, 1942, following a banquet at 7:30 p.m. Approximately 150 members were present.

Speakers were Lieutenant Colonel L. O. Grice of the Quartermaster General's office in Washington, who cited the many new problems created by modern warfare; John L. Crist, president of Southern Dyestuff Corporation, Charlotte, North Carolina, who read a paper discussing the place of sulfur dyestuffs in the present war effort; Major Frank M. Steadman of the Quartermaster Depot in Philadelphia, who spoke, among other things, of the desire of the army to stick to vat colors as much as possible; Thomas R. Smith of Wiscassett Mills, president of the National Association, who emphasized the need of continuous effort in research to keep up the Association's place technically in a nation at war.

Following the talks, discussion was held with the speakers answering questions from the members.

Respectfully submitted,

D. STEWART QUERN, *Secretary.*

TECHNICAL PROGRAM CHAIRMAN FOR ANNUAL MEETING

PRESIDENT Thomas R. Smith has announced that Kenneth H. Barnard has consented to again serve as chairman of the technical program committee for the 1942 annual meeting. Technical problems concerning the country's war effort and the Intersectional Contest will feature the program.

The meeting will be held under the auspices of the Philadelphia Section during the last three months of 1942, on a date to be selected. It will be held at either Philadelphia or Atlantic City, probably the latter.

UNEMPLOYMENT REGISTER

Members of this association, who are without employment, should forward to the secretary a statement as to their qualifications and experience. This information will subsequently appear on these pages with an identifying key number. Employers are also requested to file with the American Dyestuff Reporter any vacancies which may occur in their business.—H. C. Chapin, Secretary, Lowell Textile Institute, Lowell, Mass.

NOTICE TO EMPLOYERS

Personal Histories and Employment Records of the following applicants are on file at the office of the American Dyestuff Reporter. Prospective employers may examine them without obligation.

Key: A—Laboratory and research; B—Dyeing or printing; C—Finishing; D—Sales; E—Instruction; F—Executive.

NOTE: PERSONS WHO HAVE OBTAINED EMPLOYMENT SHOULD NOTIFY THE SECRETARY OR THE AMERICAN DYESTUFF REPORTER AT ONCE.

A-1

Education—Graduate textile chemistry and dyeing course, Lowell Textile Institute, 1932. Special course in colloid chemistry at M.I.T.

Experience—Library work in spare time while attending school; five years as assistant chemist with knitting mill, duties consisting of testing and grading silk, testing of oils, soaps, dyes, finishes and other chemicals, making up specifications for various lines of hosiery and checking finished product, keeping a check on production costs, control of waste and irregulars, checking competing products and carrying on research to improve product and reduce costs. Woman; age 30; references.

A-2

Education—B.T.C., Lowell Textile Institute, 1933.

Experience—Textile chemist, cotton and rayon thread; agricultural chemist, protein, fat and mineral analysis; special Federal inspector on textiles, New York City; U. S. inspector, war department; chemist-spotter, dry cleaning experience. Age 32; married.

A-3

Education—B.S. in chemistry, Lehigh University.

Experience—Experimental engineer and analytical chemist, 8 mos.; assistant superintendent of silk corporation, assisted in planning and directing production, in charge of laboratory, technical work, personnel, purchasing, etc., 2 years; inspector of ordnance material, to the present. Seeks position as chemical engineer or chemist.

Age 25; single; references.

A-B-9

Education—Textile School Graduate; Alexander Hamilton Institute Business Course.

Experience—Mature, executive type of textile chemist and colorist with over twenty years' broad general experience in factory, laboratory, purchasing and all around business procedure. Good correspondent. Excellent personality. Wholesome appearance. Fine speaker. Literary and artistic ability. Real color sense. Possesses fund of factual information about material things in a wide range of industries. Capable of meeting the highest type of clientele and planning and directing the efforts of all types of personnel. Desires supervisory, contact, promotional or sales work. Willing to prove ability and versatility.

Age 44; American born; New England Yankee ancestry; married.

A-B-16

Education—3 years analytical textile chemistry and 2 years textile dyeing at Rhode Island School of Design.

Experience—6 years assistant research chemist at cotton finishing plant. Had charge of putting all research into production; complete study of starches, dextrines, gums, resins, finishing oils, softeners and sulfonated oils; considerable microphotography experience; wash and light tests on dyestuffs; knowledge of all cotton finishing operations; experience in water treatment; recent experience as dyer of wool, cotton, rayon (stock and piece goods), and mixtures. Seeks position as chemist, dyer or laboratory technician.

Age 30; American; married; references.

A-B-17

Education—Graduate of Franklin Union and Lowell Textile Institute, 1942.

Experience—1936 until present as assistant dyer in hosiery dye works. Experienced on full fashioned and anklet hosiery, handling wool, cotton, silk, rayon and nylon and combinations; has charge of weighing dyestuffs, testing and shade matching; experience with hosiery dyeing machines of all sizes. Seeks position as assistant dyer or laboratory technician.

Age 24; married; references.

A-B-18

Education—Graduate Philadelphia Textile School, 1940.

Experience—Has experience as assistant chemist and trouble shooter in silk dyeing and finishing plant; as manager of laundry store; and as printer and colorist in screen printing plant. Seeks position in laboratory and research, dyeing, printing or finishing.

Age 21; single; references.

A-B-C-F-3

Experience—Broad experience since 1906 as overseer of finishing, general researcher, trouble shooter, overseer of dyeing, general superintendent, mill manager. Experienced in woolen, worsted, cottons, unions and mixtures. Recently specialized in men's wear cottons. Seeks position as overseer of finishing or dyeing, assistant superintendent, superintendent or manager.

Age 53, married; references.

A-C-D-1

Education—Chemistry, Temple College, Philadelphia, evenings. Dyeing and textile chemistry, Philadelphia Textile School.

Experience—Employed about 18 years in textile mill, becoming chemist; 5 years as superintendent of finishing on silk and rayon ribbons; 10 years as salesman of chemicals and textile specialties in eastern Pennsylvania and parts of New Jersey; has some knowledge of the processing of all textiles. Seeks position as salesman with well known company.

Age 48; married.

B-10

Education—2 years chemistry, 2 years textile chemistry and dyeing, Lowell Textile Institute, evenings.

Experience—4½ years dyeing and bleaching hosiery, specializing in children's and infants' hose; 3 years assistant dyer, dyeing and bleaching cotton, mercerized and unmercerized, wool, wool-cotton, wool-rayon and wool-silk hose. Seeks position as second hand, assistant dyer or laboratory assistant in hosiery mill.

Age 27; single; references.

B-D-1

Education—High school graduate; textile chemistry, Textile Evening High School, New York City; accounting; typist.

Experience—from 1935 to present employed as colorist with screen printing plant in New York City. Experienced with all types of fibers and all types of dyes. Shade matching. Versed in accounting, typing, modern office procedure and sales promotion. Able assistant to busy executive. Age 46; single; references.

LAPEL BUTTONS
bearing the seal of
the Association
may be purchased
by members in
good standing, from
the Secretary,
for $1.50 each.

TRADE NOTES • NEW PRODUCTS

• CONTRIBUTED TO FUND

The Chemical Industry in 1941 gave $39,962 to the Greater New York Fund as its contribution to help support 400 affiliated voluntary welfare and health agencies.

In making public these figures, James A. Farley, 1941 campaign chairman, said that $33,737 came from firms, and $6,225 from employee groups. The total contributed by the Chemical Industry is an 8 per cent increase over its gifts to the Fund in 1940.

• NIPOCER

Nipocer, a synthetic wax manufactured from freely available, domestic raw materials is now being made by the Glyco Products Co., Inc., 230 King St., Brooklyn, N. Y.

Nipocer is a tan colored wax with a melting point of 46°-49° C. It is said to blend with most waxes and resins and to be easily emulsified with the usual emulsifying agents. It is claimed that Nipocer is superior to Japan Wax in that it is less subject to oxidation and rancidification and is always uniform. It is stated that it is being used in textile preparations, lubricants of various types, protective coatings, impregnants, polishes, and for most purposes where a wax with the properties of Japan Wax is desirable.

Further information, samples, etc., can be obtained from the manufacturers.

• "RAYFLEX"

The entire output of "Rayflex," a high-tenacity rayon yarn made by the American Viscose Corporation, is now being used for making self-sealing gasoline tanks for military airplanes and tire cords for heavy duty tires, the bulk of which are for Army trucks, reconnaisance cars, and other motorized military equipment, the company announced recently. It is stated that the use of "Rayflex" for tire cords is helping to conserve the country's supply of rubber, since tires made with rayon cords require less rubber and last longer than those made with other types of cord.

• CHROMIUM ALLOCATED

Chromium, already strictly controlled, on February 4th was placed under a complete allocations system by the Director of Industry Operations by an amendment to Order M-18-a.

The amended order provides that no chromium may be melted except with specific authorization of the Director of Industry Operations. It is designed to prevent depletion of existing stocks, and to control further the flow of this important steel alloy.

The recent order, together with Order M-21-a which limits the uses of chrome steel, makes use of the metal completely subject to the Director of Industry Operations.

M-18-a, as amended, revokes Order M-18 and took effect upon issuance. It expires on June 30, 1942.

• WOOL PRODUCTS LABELING

Restrictions on the use of wool and the development of fabrics made of substitute fibers will have the effect of intensifying the demand for the enforcement of the Wool Products Labeling Act, according to a bulletin issued recently by Waldo Grose, Sales Manager of the Women's Ready-to-Wear Department of the Botany Worsted Mills of Passaic, N. J. The bulletin, entitled "The Wool Products Labeling Act in a War Economy," is being distributed to 10,000 Botany garment manufacturers and retail store customers.

During the last five years, Mr. Grose states, informative labeling has become increasingly a policy in the merchandising practices of progressive manufacturers and merchants. As a fundamental part of the informative labeling movement the Wool Products Labeling Act will be jealously guarded for its value in protecting the public during a war-time period of enforced lowering of quality standards.

"Among the broad general powers vested in our national War Emergency organizations," the bulletin declares, "none will be used with greater energy than those designed to protect the public interest. There is a powerful consumer-conscious group of individuals in these organizations, who, in business life, have been among the foremost proponents of informative labeling which includes not only a statement of fiber content, but other facts bearing on the wear and service of consumer goods."

Should the use of increased quantities of reprocessed and reused wool be necessitated by the exigencies of war, the consumer will demand to know it and should know it, Mr. Grose declares, and processors of these goods should be proud to supply this information. If their products meet consumer requirements, the manufacturers will be establishing a public confidence which will endure beyond the emergency period, into the only market worth having—the permanent peace-time market.

• SALVAGE KNIGHTED

Samuel Agar Salvage, Dean of the American rayon industry and a Director of the American Viscose Corporation, was knighted by King George VI as Knight Commander of the Order of the British Empire in the King's New Year's honors list, it was announced recently. The honor was given in recognition of a long career devoted to the service of Great Britain and the United States, to advancement of the rayon industries of the two countries, and for work in organizing the British War Relief Society of which he was the first president.

Sir Samuel was born in London in 1876 and came to the United States in 1893. He entered the cotton yarn business, but early became interested in the possibilities of rayon and obtained the American representation for the rayon yarn produced by the English firm of Samuel Courtauld & Co., Ltd. Later he persuaded Courtaulds to purchase the American rights for the patents covering the viscose process of making rayon yarn. In 1910 he was instrumental in founding the company which is now the American Viscose Corporation. He was in charge of sales for the new company from the beginning until 1925, when he became president, a position he retained until 1937. Thereafter he was chairman of the board of directors until December 31, 1939, when he resigned this post but continued active as a director of the company.

• NEW RAYON SIZE

Development of a new chemical size for use on rayon yarns that are to be knit into hosiery was announced recently by the American Viscose Corporation. It is expected by the manufacturers that the new size known as "Avconit No. 1," will increase manufacturing efficiency throughout the entire hosiery manufacturing process, will materially reduce the number of irregulars or imperfect greige hose, and consequently should result in lower production costs for manufacturers making rayon hosiery.

It is stated that "Avconit No. 1" will enable rayon yarns to hold their twist during manufacture into hosiery, and is as effective on low twist as on high twist yarns. It is quite possible, it is said, to hold 75-denier 40-turn yarn when this size is used. In addition, "Avconit No. 1" affords lubrication to the yarn for knitting and protects fabrics, reducing damage to them due to snags and the like during manufacture.

In marketing "Avconit No. 1," the American Viscose Corporation will issue licenses to throwsters to use the size on a royalty-free and fee-free basis, and will then provide technical assistance to service the licensees and instruct them in the handling and application of the new product. Requests for licenses have already been received from a number of throwsters and it was expected that initial shipments of

"Avconit No. 1" would be forwarded to them in February.

• CHEMISTRY TEACHERS MEET

On Saturday, February 7, the New England Association of Chemistry Teachers met at Rhode Island School of Design in Providence. This was the 213th meeting of this group of instructors in the Chemistry field from the high schools and colleges of New England.

At 10 o'clock J. Kenneth Berry, head of the Department of Textile Chemistry at Rhode Island School of Design, spoke on the subject "Dyeing with Coal Tar Dyestuffs," and accompanied his lecture with a demonstration. He was followed by A. S. Rollings, head of the Department of Industrial Design at Rhode Island School of Design, with a lecture and demonstration on "Decorative Enamels." Following a business meeting and luncheon, Dr. Richard D. Goldthwaite, instructor in Geology at Brown University, spoke on "Ice Crystals on the Move," followed by J. W. Stillman of the E. I. du Pont de Nemours & Co. on "Chemistry's Contribution to Present Day Living." The meeting was closed with a U. S. Government film entitled "The River."

• CLOTH "SECONDS"

The Army will occasionally buy cloth "seconds" under certain special conditions where the purchase will not interfere with the serviceability of the garments to be made from this cloth, the War Department announced recently. The idea is to help the clothing trade dispose of their seconds and meet deliveries when unusual speed is required.

The Philadelphia Quartermaster Depot has forwarded to the Office of The Quartermaster General in Washington several samples of mackinaw coats made with wind-resistant poplin which contained weaving imperfections such as broken picks, streaks and bars in the filling. Because of the shortage of material for this garment, the Office of The Quartermaster General has authorized the use of this cloth, which is classified as "seconds," since it does not affect the quality of the garment. Authority will be granted for acceptance not to exceed 10 per cent of the "seconds" on contracts and a discount of 15 per cent in the contract price. In this way it will be possible to obtain a substantial increase in production of mackinaw coats.

The "seconds" will also be used occasionally for making such limited issue items as sleeping bags, parkas and hoods worn by soldiers in cold climates. Purchases by the Philadelphia Depot during the first week in January included 94,000 yards of wind-resistant cloth "seconds" and 497,500 yards of cotton drill substitute "seconds."

• PRICE LIST

A new 16-page price list for Silver-Ply stainless-clad steel has just been issued by the Jessop Steel Co., 501 Green St., Washington, Pa.

The new price list contains base prices for sheets and plates of Silver-Ply for twelve grades of cladding, in proportionate thicknesses of cladding from 5 to 50 per cent. The section on standard classification of extras for plates includes tables on matching, shearing and flatness tolerances, estimated weights, and size limits for standard production plates and sheets. The standard classification of extras for sheets includes extras for finish, shearing, size, quantity, etc.

The last section of the price list contains prices for forming standard flanged and dished heads, A.S.M.E. — A.P.I. flanged and dished heads, and elliptical dished heads, as well as prices for machining heads.

Copies of the new price list are available free upon request.

• BLACKOUT PAINTS

The chemical laboratories of the Wilbur & Williams Co., paint manufacturers, Boston, Mass., have recently released a brief but concise bulletin on the proper use of emergency paints for blackout purposes. Among the items covered are the following: window glass blackout exterior paints, window glass inside white paint, window glass blue translucent paint and white traffic guide paint. Copies of the bulletin and information regarding the paints may be obtained by addressing the above-named company at the Park Square Building in Boston.

• GENERAL RELEASES

General Dyestuff Corp., 435 Hudson Street, New York City, has recently released circulars describing the following products:—

Benzoform Bordeaux 7B—a direct color recommended by the manufacturers for the dyeing of cotton and, in particular, of rayon. When aftertreated with formaldehyde and acetic acid, in the usual manner for Benzoforms, it produces fairly bright, bluish shades of red said to be of comparatively good fastness to washing, water and perspiration. The product is said to be well suited for use on materials which require wet-fastness beyond that obtainable with the average direct color. It is not particularly suitable for white discharges, but can be used as a ground for colored discharge styles. It dyes silk effects somewhat lighter and yellower than the vegetable fibers and stains acetate rayon effects slightly. In union dyeing at the boil, the wool is dyed considerably yellower than the cotton, while at about 150° F., the wool is dyed considerably yellower and weaker than the cotton. The addition of chrome to the formaldehyde bath turns the shade somewhat redder; copper sulfate turns it much bluer. Neither addition improves the fastness to light or washing. Circular G-305.

Supranol Yellow RA—a neutral dyeing acid yellow particularly well suited for the dyeing of hosiery. It is said to possess good affinity for silk from the slightly alkaline bath usually used in hosiery dyeing and, at the same time, leaves acetate rayon effects unstained. It is also valuable for use on the various forms of wool, being applicable from either a neutral or a weakly acidic dyebath. It is stated that, due to its good all-around fastness, it can be employed for dyeing materials of all kinds: loose wool and slubbing which will be subjected to fulling; yarns which must be fast to water, sea-water, perspiration and washing; piece goods which are required to be fast to light, washing and hot pressing. It can be advantageously used for union dyeing. Circular G-304.

Fastusol Grey LRA—a direct dyestuff which produces reddish shades of grey characterized by their very good fastness to light. It is well suited for dyeing the various forms of cotton or rayon. The dyeings can be discharged to a very good white with either neutral or alkaline discharge pastes and, in addition to very good light fastness, possess good fastness to perspiration and very good fastness to acid and alkali. In union dyeing at the boil, it stains the wool comparatively little. At temperatures around 150° F. the wool is but slightly tinted and can be kept practically white by the addition of Katanol WB Conc to the dyebath. It leaves acetate rayon effects clean and only slightly stains silk effects. Circular G-306.

• DU PONT CHANGES

Charles L. Wiswall, Director of Sales of Du Pont's R. & H. Chemicals Department since 1933, has been appointed Assistant General Manager of the newly created Photo Products Department, effective February 15.

Samuel C. Harris, Assistant Director of Sales of the R. & H. Chemicals Department since 1936, succeeds Mr. Wiswall as Director of Sales.

Mr. Wiswall was graduated from Colgate University in 1915. He was connected with Hercules Powder Company and Vulcan Detinning Company before joining Roessler & Hasslacher Chemical Company in 1920. That company was merged with Du Pont in 1930.

Mr. Harris was graduated from Davidson College in North Carolina in 1917, and has been connected with Du Pont or Roessler & Hasslacher ever since. He was with Du Pont from 1917 to 1922, when he left to join the sales staff of Roessler & Hasslacher.

• CALCO BULLETINS

The Calco Chemical Division of the American Cyanamid Company, Bound Brook, New Jersey, has recently issued two bulletins of timely importance. The first is a study on the dyeing and finishing of various materials which may be used for blackout draperies and curtains. It covers the requirements which the material used for this purpose should have and then discusses the types of materials which best meet these requirements. The bulletin also outlines many dye formulas which are recommended for use on these materials.

The second bulletin outlines the requirements and gives a suggested dyeing formula for the dyeing of Army nurses' uniforms—dark blue shade—which is covered by U. S. Army Specification No. 8-122.

• LIFE OF A UNIFORM

Army Quartermasters Corps statisticians have studied the approximate life of the average soldier's uniform and the replacement items required during his second year of service. They claim his woolen coat lasts 33 months; his woolen trousers, 14½ months; overcoat, 3 years; service shoes, 5 to 7 months; woolen shirt, 6 months; and garrison cap, 14½ months.

These figures take into account average conditions of wear in continental United States. In combat zones, wear of clothes depends on local factors, notably the weather and the type of treatment they are given, the statisticians point out.

Cloth requirements to fully equip and maintain a soldier for one year are as follows: woolen cloth, 29.253 yards; cotton cloth, 122.182 yards, according to the latest official estimate.

Perhaps the most significant finding of the study concerns the comparative wearing qualities of woolen and cotton garments. Woolen cloth does not always outwear cotton cloth. However, cotton trousers wear less than half as long, on the average, as woolen trousers; and woolen undershirts, and shorts, about 5 times as long as those made of cotton.

In considering the wear of these items, an important factor is the number of each one that is originally issued to the soldier. He gets only one overcoat and one woolen coat as original issue, along with 3 pairs of shoes; 4 pairs of cotton khaki and 2 pairs of woolen trousers; 6 shirts—4 cotton khaki and 2 woolen; and 2 caps—1 woolen and 1 cotton khaki (except in the tropics).

• NEW BIRCH MACHINES

Birch Brothers, Inc., of Somerville, Mass., have recently introduced an addition to their line of cloth opening and folding machines, commonly called scutchers. Both their standard and heavy duty ball bearing machines are now built with an extended folder designed particularly for use with squeeze rollers. These machines are said to eliminate the use of a folder separate from the opener and take a minimum of space and erection work. After the cloth passes through the governor, it passes over a guide roll to the squeeze rollers and then up again to the folder. The machines are built in all widths.

They have also introduced a new heavy duty two roll rack and pinion batcher designed particularly for heavy material, such as duck, heavy cotton, burlap, and other fabrics where it is desired to make a large roll. The machine is suitable for use in cotton finishing plants, felt and woolen mills, etc., in connection with open-width processing, tenters, dryers, padders, calenders, etc.

Literature will be sent on request.

• FLORITE DESICCANT

Florite Desiccant a new granular drying agent for gases and liquids, has recently been placed on the market by the Floridin Company, 109 Liberty Street, Warren, Pennsylvania. It is claimed that Florite Desiccant has not only been accepted as completely satisfactory in a variety of industrial processes requiring bone dry gases and liquids, but has also proved economical in many installations where high drying efficiency is not ordinarily demanded. It may also be used in breathers for storage tanks and electrical transformers, to dehumidify air in air conditioning systems and to dehydrate refrigerants.

The outstanding characteristic of Florite Desiccant is said to be its ability to maintain a high drying efficiency under conditions that have rendered competitive materials useless. It is stated that it adsorbs water instantly and will not swell, disintegrate, or appear wet at the end of an adsorption cycle. It is hard, stable, noncorrosive, and non-poisonous. Florite Desiccant selectively adsorbs 4 to 20 per cent of its weight in water, depending on the particular application, and is regenerated by heating to 300-350° F.

Descriptive literature is available on request.

• MEETING, S.C.I.

A meeting of the American Section of the Society of Chemical Industry was held on February 20th at The Chemists' Club, 52 East 41st Street, New York City. This was a joint meeting with the American Institute of Chemical Engineers. The Chairman, Dr. Lincoln T. Work, presided.

The topic of the evening "What Is Research?" was discussed from various aspects. The first speaker, Dr. Lincoln T. Work, Director of Research of the Metal and Thermit Corporation, asked the question "What Is Research?" citing the broad definition of the term "research" as it is used today and pointing out the need for considering the many-sided activities now called research in order to ascertain the distinguishable points of difference between fundamental scientific investigation, process development, investigation for the improvement of plant practice, etc. He stressed the importance of understanding the place of research in our industrial structure.

Mr. Frank G. Breyer, of Singmaster and Breyer, discussed the question from the consultant's viewpoint.

Dr. George O. Curme, Jr., Vice-President of Carbide & Carbon Chemicals Corporation, dealt with the question from the industrial viewpoint. He pointed out that the established tradition of clear expression of thought in chemistry and contrasted with that the confusion of meanings of the word "research" as commonly used. Dr. Curme outlined the uses made of experimental investigations in industry. He pointed out that difficulty arises from each group speaking in terms relative to its own fortuitous position and not in terms describing function, relative to profession as a whole.

Taking the subject from an institutional viewpoint, Dr. L. W. Bass summarized how the optimum conditions for successful basic industrial research—inspirational atmosphere, expert guidance and consultation, adequate equipment, and freedom from dispersion of effort—are fulfilled to exceptional degree by the industrial research institute. Institutional research because of its administrative and physical separation from industrial routine, is inherently less subject to the interruptions of trouble-shooting and short-range problems.

• NEW MATHIESON PLANT

In accordance with a contract which has been signed by the Defense Plants Corporation and The Mathieson Alkali Works, Inc., work on a new plant for the production of metallic magnesium and chlorine will be begun immediately, according to an announcement made by E. M. Allen, President of the Mathieson Organization.

The plant, which will be located at Lake Charles, La., and will cost approximately $22,500,000, will be owned by the Defense Plants Corporation. It will be operated by Mathieson and will produce about 36,000,000 pounds of magnesium a year by a process developed by Mathieson.

This process differs from other processes for making magnesium electrolytically, in that it does not consume chlorine but produces it in such concentration that it can be collected and liquefied.

The magnesium produced by the Mathieson process is obtained from dolomite, a rock resembling limestone and consisting of calcium-magnesium carbonate, which will be shipped from nearby quarries. This material is calcined, using locally produced natural gas for the purpose, and the re-

sulting oxides of calcium and magnesium are treated with calcium chloride, a product of the process by which soda ash is made at one of the Mathieson plants, also located at Lake Charles. The mass is then treated with carbon dioxide, obtained from the calcination of the dolomite, which converts the calcium into the insoluble carbonate, leaving magnesium chloride.

The magnesium chloride, after being concentrated, is electrolyzed in a new type of cell, which was independently developed by Mathieson in conjunction with The Consolidated Mining and Smelting Company, of Canada, Ltd. The products are metallic magnesium and chlorine, both of which are essential war materials.

● TEXTILE RESEARCH

Heretofore unknown facts about fibers, dyes, and textile chemicals will be revealed with the new electron microscope described in the February issue of *Textile Research*, official publication of Textile Research Institute, Inc., and of the Textile Foundation. Also discussed in that issue is the development through research of electrocoated fabrics.

Opening up to view infinitely small particles, the electron microscope provides a valuable research tool for science and industry. This new instrument permits magnifications 50 times greater than can be obtained with ordinary microscopes and permits study of objects even more minute than the wavelength of light. Among its potential applications is investigation of the effect of chemical and mechanical treatments on the fundamental properties of textile fibers.

Other features of the February issue of *Textile Research* include the announcement of a new plant developed by Textile Research Institute for facilitating cooperative research on textile problems; an article by Richard W. Sulloway on the value of research in small plants; discussion of methods of financing research projects; a report on the relation between the construction of cotton fabrics and their resistance to water; and a description of a process for producing sequoia bark fibers for blending with wool.

● REDUCTION IN PRINTS

Print cloth manufacturers, printers, and converters were advised by telegram on February 23rd by Robert R. Guthrie, Assistant Chief of the Bureau of Industry Branches, of a forthcoming WPB order that will require a reduction in the number of patterns and strength of pattern colors.

Print cloth includes most summer dress materials, draperies, and slip covers.

According to Mr. Guthrie's telegram, the number of patterns for print cloth will be cut in half; shades will be lighter than at present, with the heavier shades prohibited; and less of the cloth will be colored, leaving more white background.

The telegram was sent out in advance of the order to give manufacturers an opportunity to make their plans for next season's patterns before contracting for patterns that will be prohibited under the order.

The telegram follows:

February 23, 1942.

On all new patterns it is proposed to recommend for prompt issuance an order providing that designs be made with the idea in mind of not over fifty per cent peg coverage when used on white grounds or commercial tint ground; blotch patterns designed should have peg coverage not over forty per cent; blotches should not be deeper than class two on vat or pigment dyes, or class B on all other dyes. There should be no more than four color combinations per pattern; and it is further contemplated that lines be cut to not over fifty per cent of the number of patterns carried in last season's line. This telegram is for your information so that you may govern your activities accordingly.

Robert R. Guthrie, Chief,
Textile Clothing and Leather Goods Branch

● CHLORINATED RUBBER STOCKS

All stocks of chlorinated rubber in the United States, except those going into specified uses, were ordered frozen on February 23rd by J. S. Knowlson, Director of Industry Operations, preparatory to requisitioning by the War Production Board or diversion into war production.

An amendment to General Preference Order M-46 provides that chlorinated rubber may be used only for these purposes:

As a paint for interior use in industrial plants where resistance to chemical corrosion is necessary; as a paint in arsenals, and for painting ship bottoms and other submarine uses.

For flame-proofing military fabrics, including tents.

For tracer bullets.

For adhering rubber articles to metal.

For electrical insulation.

Stocks on hand for all other uses, effective on the order date must be reported at once to the Chemicals Branch, War Production Board, and held for later disposition.

While facilities for the production of chlorinated rubber are being increased greatly, current military demands are greatly in excess of supply. The material has been under a monthly allocation system since November 1, 1941, and none is now going for non-military use.

Among the principal civilian uses for chlorinated rubber which are prohibited by the order is the treatment of fabrics, papers and printing inks for greaseproofing and to increase resistance to chemical action.

● CALCO BOOKLET

Many textile concerns will be compelled shortly to change their business over from civilian production to the production of goods required by the Government. Calco Chemical Division of the American Cyanamid Company of Bound Brook, New Jersey is endeavoring to aid these concerns in this change-over by issuing bulletins on the various classes of goods required by the Government.

The latest bulletin, No. 632, entitled "Dyed Cotton Textile Items for War Use," is now available for distribution. Copies may be obtained by writing the Calco office at Bound Brook, New Jersey.

This bulletin lists the important cotton textile items required by the Government, summarizes the methods of processing them, lists the type of dyes now permitted, and the specifications required for each.

As fast as possible, additional bulletins are being released which will give the specifications, dyeing procedures and formulas for various items procured by the Government.

● MAXIMUM WOOL PRICES

Uniform maximum prices for domestic shorn wool will be established under the first permanent price regulation issued by Leon Henderson, Administrator, Office of Price Administration, since he took office under the Emergency Price Control Act of 1942 on February 11 last.

This maximum price regulation No. 106, which became effective February 28, 1942, establishes dollars and cents maximum prices for grease wool sold on a clean basis. The ceiling established is on the basis of 37.1 cents per pound for grease wool, which is the average farm price prevailing on December 15, 1941. The latter is the highest of four prices which, under the Act, the Administrator must use in setting maximums for agricultural commodities. These four prices are 110 per cent parity; the market price on October 1, 1941; the market price on December 15, 1941; or the average price during the period July 1, 1919 to June 30, 1929.

The ceiling on wool on a clean basis is $1.18 per pound for fine 64s, 2½ inches and longer, which, as is the case for other grades, generally reflects the Boston market price on December 15, 1941.

The new regulation supersedes Price Schedule No. 58 insofar as it covered domestic shorn wool. The old schedule was a "freeze" type, using as its base period October 1 to December 15, 1941.

A brokerage commission of not more than 1 per cent of the applicable maximum price is provided for. This, of course, does not apply to wool handled on consignment.

The Adsorption of WETTING AGENTS by Wool

GEORGE C. LE COMPTE and JOSEPH W. CREELY

As previously pointed out by Neville, Jeanson and Smith[1], economy in the use of wetting agents depends not only upon the wetting efficiency of the wetting agent, but also upon the rate at which it is exhausted from solution. In their paper it was shown that anion-active wetting agents would be strongly adsorbed by wool from solutions having pH values below the iso-electric point of wool, namely pH 3.5, and only slightly adsorbed from solutions having pH values above the iso-electric point. Although at that time there were no cation-active wetting agents with which to experiment, they predicted on theoretical considerations that such wetting agents would be little adsorbed by wool below pH 3.5 and strongly adsorbed by wool from solutions having pH values above 3.5. The present work has been done to demonstrate the truth of the prediction and also to investigate the adsorption by wool of wetting agents of a neutral nature, that is, wetting agents dissolving in water as non-ionizing solutes, without the formation of either positive or negative ions.

As an example of a wetting agent of a non-ionizing nature we might take the ester formed from one molecule of a fatty acid such as oleic, and one molecule of a polyethylene glycol. With enough units in the polyethylene glycol molecule the ester formed from it would be soluble enough to be an effective surface active chemical. The solubilizing effect would be conferred by the ester grouping in the molecule, the free hydroxyl group at the end of the polyethylene glycol group, and mainly by the multiplicity of ether linkages in the polyethylene glycol group. Such a compound would dissolve in water without the formation of either positively or negatively charged ions, and hence would not be adsorbed by wool in either alkaline, neutral or acid solution because of salt formation with the acid or basic groups on the wool. Of course in the wetting of any solid by a solution of a wetting agent there is the possibiltiy that the interfacial tension between the solid and the solution of wetting agent would be lower than that between the solid and the liquid without the wetting agent present. If such is the case, we know by the Gibb's equation that the wetting agent will concentrate at the solid-liquid surface thus formed, simply because of the decrease in free energy resulting. Although this cause of adsorption could function with all wetting agents, it is still true that the non-electrolyte wetting agents would not be adsorbed on wool because of electric charge effects and would for all round use be more economical than either cation-active or anion-active wetting agents.

In measuring the adsorption of wetting agents wool was wet out in twenty times its own bone dry weight of the solution to be tested. The wool and solution were allowed to stand for 25 hours at 20° C. Five milliliter portions of the solutions were withdrawn at the beginning and end of each adsorption experiment and were evaporated and heated to constant weight at 105° C. in tared containers. From the difference in the amount of residue found at the beginning and end of each experiment the amount of adsorption was determined. In all cases the concentrations of wetting agents used were such as to give approximately 0.4 per cent residue. For any given wetting agent the adsorptions were determined from each of three solutions containing initially either 1 per cent HCl, 0.05 per cent HCl, or 1 per cent NH_3. pH measurements on these solutions at the end of these experiments indicated that the 1 per cent HCl solutions finished up with pH values of somewhat less than 1.0, the 0.05 per cent HCl solutions with pH values of 3.0 to 3.5, and the 1 per cent NH_3 solutions with pH values of 11.0 to 12.0. Residues were determined on the ammoniacal solutions by evaporating them directly but the acid solutions were neutralized with 0.5 *N* NaOH solution before evaporation and in the latter cases the residues were corrected for the amounts of NaCl the titrations had indicated. The residues found were further corrected for the amounts of residue found on allowing wool samples to stand 24 hours with the HCl or NH_3 solutions without wetting agents present. The wool used in these experiments was a scoured wool containing 0.32 per cent grease, 0.85 per cent ash, and 1.02 per cent alcohol extract.

The constitutions and percentages of moisture present in the different compounds tested are shown in Table 1.

TABLE 1

Wetting Agent	*Composition of Active Material*	*Per Cent Moisture*
1	Sodium salt of a sulfated fatty alcohol	70.0
2	Sodium salt of a sulfated secondary alcohol	60.0
3	Sodium salt of a sulfated higher secondary alcohol	60.0
4	$C_{17}H_{33}CONHC_2H_4SO_3Na$	80.0
5	Sodium sulfonate of an ester of an unsaturated dicarboxylic acid	1.0
6	Sodium alkyl napthalene sulfonate	7.0
7	Polymerized ethylene oxide condensation product	67.0
8	Castor amine	3.5
9	Fatty acid amine	75.0
10	Low titer soap	8.0
11	Quaternary ammonium salt	4.5
12	Quaternary ammonium salt	75.0
13	Polymerized ethylene oxide	0.0

In Figure 1 are shown the curves for the adsorptions of anion-active, cation-active, and non-ionizing wetting agents.

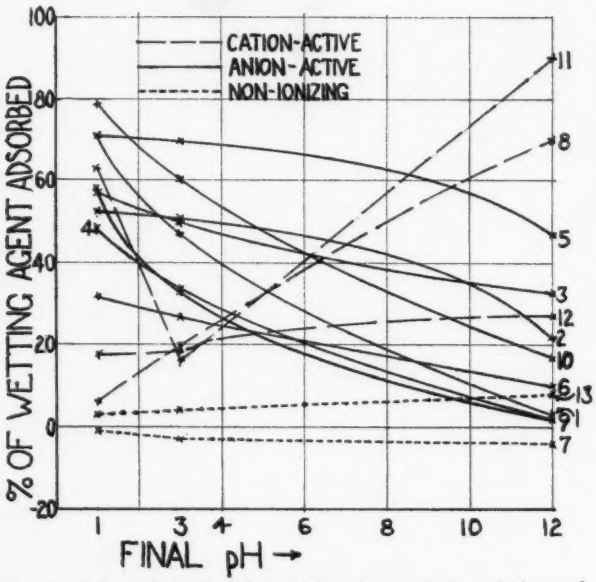

Fig. 1—Adsorption of surface active chemicals in solutions of different pH.

Of the 13 compounds tested in these experiments, 7 were anion-active, 3 were cation-active, and 2 were non-ionizing in nature. The remaining compound, No. 9 in Table 1, was described as a fatty acid amine. According to this description it would be expected that Compound No. 9 would be of an amphoteric nature but the adsorption tests indicated that it was predominantly anion-active. The 7 anion-active compounds and Compound No. 9 are shown by Figure 1 to exhibit much higher adsorptions in the acid solutions than in alkaline solution. In contrast to this the 3 cation-active materials exhibit higher adsorptions in alkaline solution than in acid solution. Finally the two non-ionizing compounds exhibit much lower adsorptions than the other materials. It is interesting to note that with these non-ionizing compounds the low adsorptions are found in both acid and alkaline baths.

The methods of analysis used in this paper had some shortcomings. As an example, the adsorption tests run with soap indicated that even in 1 per cent HCl only 79 per cent of the soap was adsorbed. Actually, when the 1 per cent HCl solutions were tested at the end of the adsorption experiment, it was found that they contained no free or combined fatty acid at all, and that the residues previously found had been composed entirely of NaCl. This NaCl had evidently been formed from the metallic portion of the soap. The amount of NaCl found was in good agreement with the amount that theoretically should have been formed from the amount of soap used. This factor of inorganic, non-surface-active salts entering into the gravimetric determinations can interfere in ascertaining the adsorption of any surface-active compound.

One of the non-ionizing compounds tested in this paper exhibited consistent negative adsorptions. This was confirmed by other experiments in which the concentration of the surface-active chemical was measured by means of the drop numbers of its solutions. It would appear that the negative adsorptions found with this compound are to be explained not only by this surface-active chemical removing impurities from the wool used in these experiments but also by a preferential adsorption by the wool of water from solutions of this chemical.

In Figure 1 it will be noted that Compound No. 11 gives a rather peculiar curve. The explanation of this probably lies in the fact that the compound gave a precipitate in the 1 per cent HCl solution. The precipitated material could be expected to tend to cling physically to the wool, thus leading to high adsorptions.

Previous to the gravimetric determinations, efforts had been made to investigate adsorption of wetting agents on wool quantitatively by means of drop numbers. In this method the first step was to determine the drop numbers of several concentrations of a given wetting agent. From these determinations curves of drop numbers against concentration were drawn. In determining the adsorption of a wetting agent on wool, the final concentration was determined by ascertaining the drop-number of the final solution and comparing with the drop number-concentration curves. In the actual determination of the drop number of a solution, the temperature of the liquid was kept at 25.0° ± 0.1° C., and 2 mls. of the solution were allowed to flow slowly from the tip of a standard pipette while the number of drops formed were counted. Often it was advantageous to dilute the solution so that the drop numbers formed would coincide with a portion of the drop number concentration curve showing a greater change in drop number per unit change in concentration.

Considerable work with the drop number method finally led to the conclusion that it was only semi-quantitative in nature. Thus, some of the compounds when tested after they had been in contact with wool showed drop number-concentration curves different from that of the original material, indicating that a selective adsorption of some components of the original material had taken place. Again, with one compound, the drop numbers changed with the time the solution stood, the change apparently paralleling an increasing turbidity in the solution. The drop number method worked rather well with some compounds and agreed with gravimetric determinations in indicating consistent and small negative adsorptions with Compound No. 7. However, because it was not applicable to all determinations its use was given up.

CONCLUSIONS

1. Anion-active wetting agents are more strongly adsorbed from acid solution than from alkaline solution.

2. Cation-active wetting agents are more strongly adsorbed from alkaline solution than from acid solution.

3. The adsorption of non-ionizing wetting agents was in general much lower than that of the ionizing wetting agents, and in fact, with one non-ionizing wetting agent, the experiments consistently indicated negative adsorption in alkaline, acid, and neutral solutions.

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Oxidation of WOOL KERATIN by Potassium Dichromate—

(Concluded from page 104)

ACKNOWLEDGMENT

We wish to thank Dr. P. Larose for his suggestions as to the preparation of a wool keratin low in ash, Dr. Florence Barr for analysis of the olive-oil soap, and Miss Virginia Ester for determination of the wool's naphtha-extractable material.

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The Water Absorption by TOWELS—

(Continued from page 108)

The absorption for two colored towels is given in Fig. 9. Although the absorption of the two towels differed appreciably before laundering, after one laundering it was improved and found to have the same value for the two samples. A comparison of this figure with those representing the results obtained with the white towel materials show that the absorption of the colored towels after laundering is just as good as that found for the white towels, contrary to the opinion often expressed that colored towels are inferior to white towels in that respect.

The results given in Fig. 10 show that for drying purposes a huck towel is also just as good, weight for weight, as a terry towel. This particular sample had been well scoured and bleached since the chloroform extraction did not affect the absorption of water.

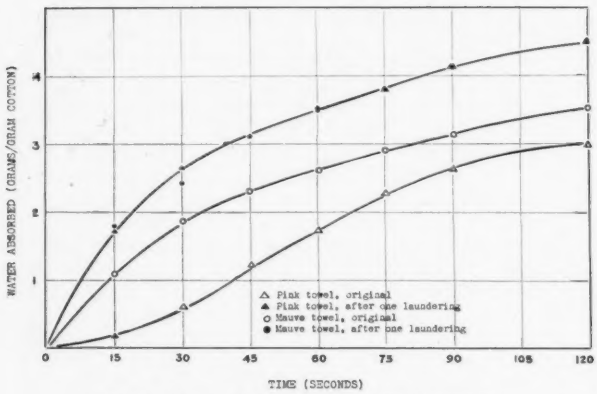
WATER ABSORBED (GRAMS/GRAM COTTON)
TIME (SECONDS)
△ Pink towel, original
▲ Pink towel, after one laundering
○ Mauve towel, original
● Mauve towel, after one laundering

Fig. 9—Water absorption of colored towels.

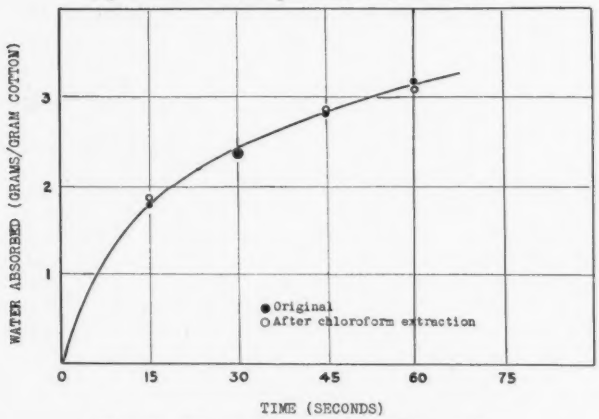

Fig. 10—Water absorption of huck towels.

CONCLUSIONS

Examination of all the results represented by the various curves in the figures show that, once the impurities, particularly the waxes or oily matter, have been removed, either by laundering or by solvent extraction, the absorption of the different samples tested is practically the same.

In making comparisons it must be kept in mind that after a towel has absorbed about 150 per cent of its weight of water it is so wet that it becomes useless for drying purposes. Any absorption beyond that point is therefore of no immediate interest. The results presented here indicate that if the material is well scoured, the towel will absorb 150 per cent of its weight of water within the first fifteen seconds. For all intents and purposes then, all the samples tested, with the possible exception of Sample 5, were equally good after laundering or after extraction.

It would appear from these results that a method of measuring water absorption such as that described in this paper would be of use not in comparing the value of one towel material with another but rather as a means of judging the effectiveness or thoroughness of a scouring treatment.

As a final remark it may be noted that the advantage of the pile in terry towels is that of adding weight and therefore absorbing material, without increasing the size or stiffness of the towel. A plain woven fabric of the same weight and size would absorb just as much water, although probably a little more slowly, but it would have comparatively coarse yarns and would feel rough and stiff in comparison to the terry material.

The author wishes to express his thanks to Mr. H. Tessier who carried out most of the measurements reported in this paper.

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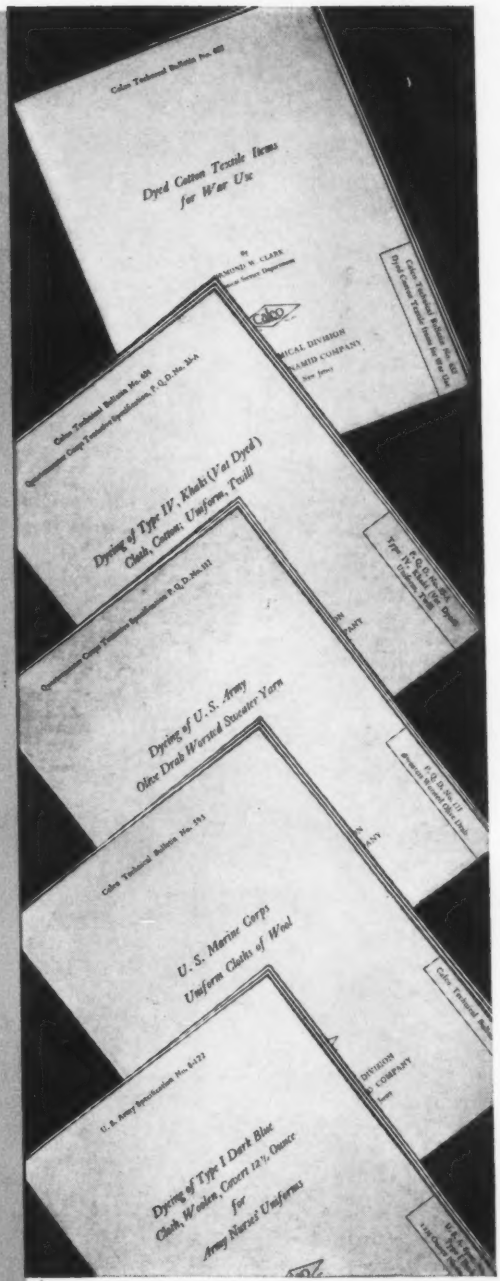
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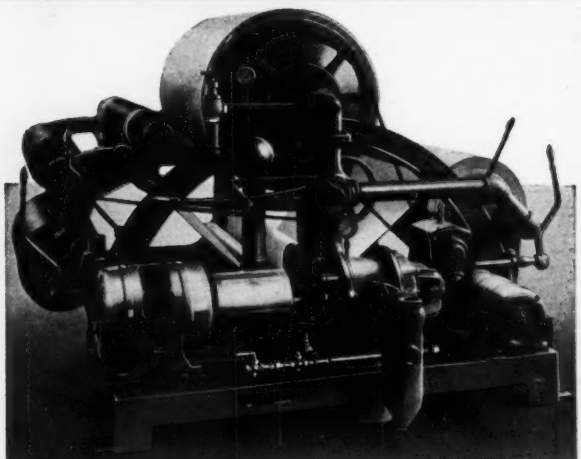

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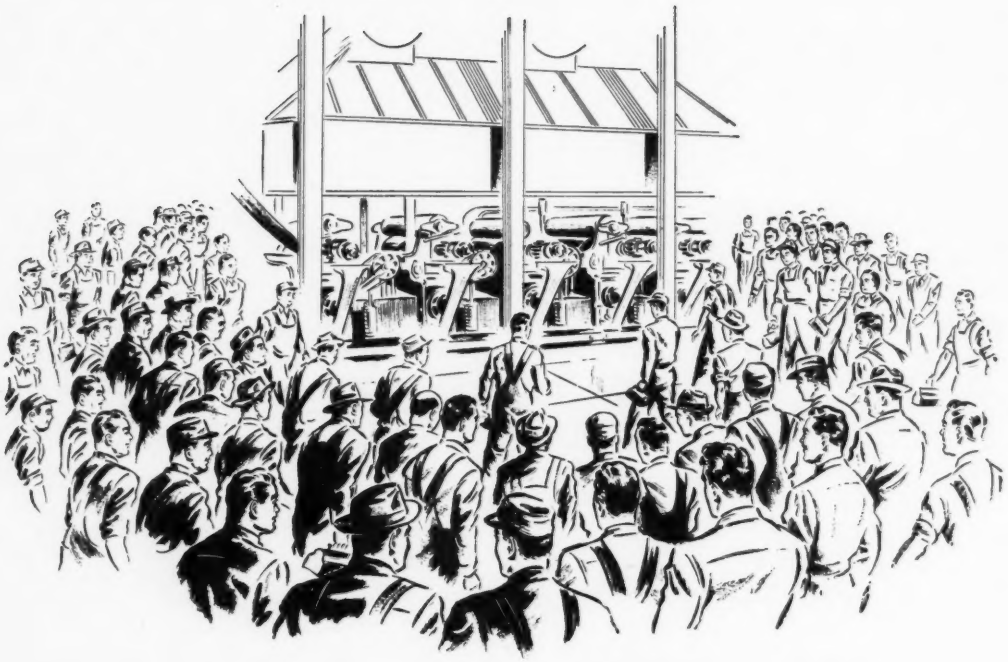

A mechanized army of 1,000,000 workers!

Lucky America to have a great Textile Industry to call on in this Emergency!

Here is a "mechanized army" of a million workers—a solid phalanx of 7,000 plants for spinning, knitting, weaving, bleaching, dyeing, finishing . . .

Producing all the textiles required for our armed forces plus a sufficiency of textiles for the "army in over-alls" fighting the Battle of Production . . . Textiles for Victory!

Only in its mechanical equipment is the Textile Industry vulnerable . . . only through deterioration of its machinery can textile production be slowed or quality of products lowered.

Engineers and superintendents are on guard against this . . . always are they on the alert—to keep their plants in the best possible state of efficiency.

Since 1820, the Butterworth Organization has served the Textile Industry in America—pioneering, building and improving machinery for the Wet End of Textile Finishing.

Today, while Ordnance production has first call on our facilities, we are still building Textile Machines as required in America's great War Program.

***64%**

of equipment now in use in the wet end of textile finishing cannot operate at a profit in competition with modern machines.

*Proved by Research

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PRODUCING GUN MOUNTS FOR THE UNITED STATES ARMY

"BEST LOOKING COUPLE . . ."

Indeed, they are! Take any fibre, or any mixture of fibres—combine with DuraBeau Finishes—and the fabric gains lavish beauty in perfect harmony with both the needs of the fibre and the demands of the market.

And, where the vital question is "How will it wear?" —DuraBeau assures wear-ability that withstands most critical appraisal.

This is extra value that SELLS! Use it in selling. By transfers, labels, inserts on packages, in all sales promotion, it pays to *say* the product is . . .

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FINISHED

for lasting beauty, added wear

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The practical advantages of

LARGE-SCALE PRODUCTION

to users of

CYANAMID QUALITY CHEMICALS

in the textile industry

(above) One of Cyanamid's modern large-capacity units for the production of textile chemicals. Large-scale production means greatest possible uniformity in chemical supply.

(left) A similar unit in another Cyanamid plant. Each step in Cyanamid's volume production methods is planned and carried out to deliver highest quality as well.

REGARDLESS of whether the volume required is moderate or in carload lots, chemicals for the textile manufacturing processes should be of a consistently reliable, uniform quality at all times.

The source of supply of textile chemicals... the sulphonated oils, penetrants, sizing compounds, wetting agents and other specialties . . . therefore becomes a primary consideration to the manufacturer in establishing economically dependable processing results.

Cyanamid recognizes this vital part played by chemicals throughout the textile industry. Cyanamid is also aware that the supplies required by the textile industry can best be provided by high-standard volume production, insuring the barrel by barrel uniformity made possible by large batch manufacture. As a result, Cyanamid has set up modern large-scale facilities adjacent to the important centers of textile manufacture.

Cyanamid today is able to assure textile manufacturers that their requirements, both large and small, will be accurately and quickly filled with chemicals of a consistently high quality.

Cyanamid is also prepared to serve textile manufacturers on problems relating to the proper selection of chemicals to meet changing specifications in production... a valuable extra service without charge or obligation that is backed by extensive research and practical field experience.

SULPHONATED OILS; PENETRANTS; SOFTENERS; FINISHERS; SIZING COMPOUNDS; DECERESOL* WETTING AGENTS

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